ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

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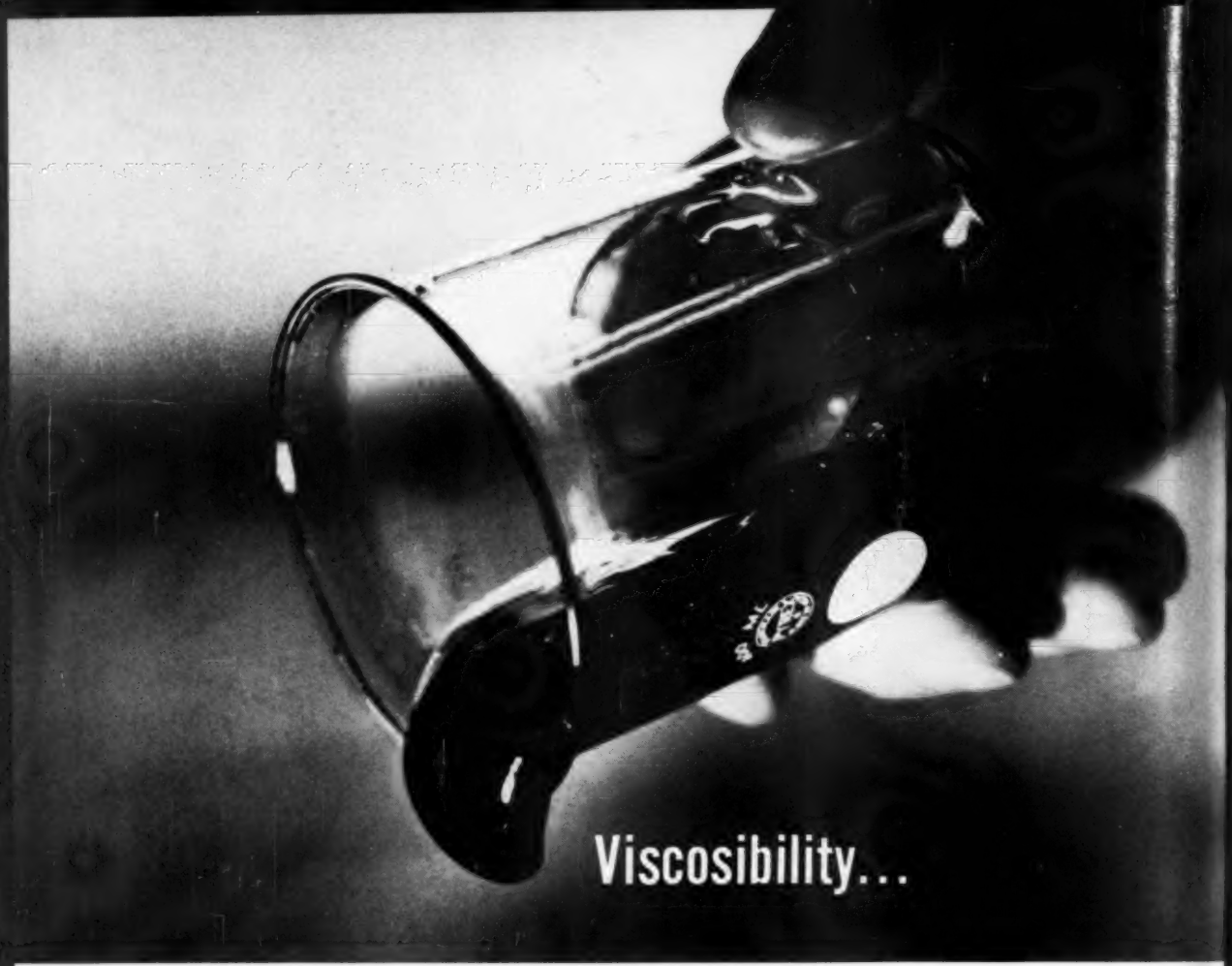
a new future for WOOD with adhesives



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aa ADHESIVES AGE

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The mature red oak log on the front cover of this issue was harvested on a Kentucky "tree farm." For more information on the drastic changes in our natural timber resources and how adhesive technology is being marshalled to meet them, see Richard Blomquist's article on "Adhesives for the Future of the Wood Industry," beginning on page 20.

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PALMERTON PUBLISHING COMPANY, IN

JUNE, 1961

VOL. 4, NO. 6

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To the animal glue manufacturer, buyer or user, "*gram*" doesn't mean HOW MUCH. It means HOW STRONG.

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WRITE FOR DETAILED TECHNICAL DATA

R&A SINCE 1913

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BLOOMFIELD, NEW JERSEY

That photo, above, shows a typical bonded mitred joint at the corner of a trampoline protective bumper. Not only are the polyethylene foam slabs bonded to each other, but the entire bumper is firmly anchored to a concrete apron . . . with the very same adhesive.

The completed bonds are subjected to all sorts of rigorous punishment in use (abrasion, impact, peel forces, etc.). In addition, since these are field installations, the assembly must withstand the broadest possible span of outdoor weathering conditions (sunlight, rain, sleet, snow, salt water, heat, cold, etc.).

Either of two high-strength, water-resistant R&A "contact bond" adhesives now make it possible for you to achieve bonds of foam-tearing strength between this expanded plastic and just about any other material.

BONDMASTER G590 is a fast-drying "contact" adhesive which can be applied by brush, trowel, paint roller, flow gun, or spray gun. At room temperature, adhesive-coated components can be mated in about 20 to 30 minutes after application. Assembly consists simply of aligning coated parts carefully before mating and then using firm hand pressure to insure intimate contact over the entire area being bonded. Bonds of foam-tearing strength develop instantly.

BONDMASTER G523-20 is a longer "open time" variation of this product for use where an extended delay between coating and assembly is desired.

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EDITORIAL

Conversion and Conversation

A considerable amount of time is being spent these days in a pursuit of market information—statistics and estimates of interest to adhesives manufacturers and consumers. A good many of these figures pass over our desk and we would be the first to recognize that there is a singular dearth of marketing information available. We are making our attempts to rectify this situation, but the knowledgeable among us will understand that it is a long and arduous task. Moreover, those figures which we have been able to unearth are often near useless because it seems that too many of us are not speaking the same language.

Let us assume that we are trying to track down an annual sales volume figure for solvent cements at the manufacturers' level. The first figure we come upon is $X representing Y pounds. This is balanced by a $Z figure representing W gallons. Obviously, the dollar figure is considerably different in both cases and the quantity figure is almost unreconcilable. How has this come about?

One market analyst has figured *dry*. He reasons that the best way to come up with an intelligent figure is to utilize the total solids rubber content. Thus, he arrives at a figure and a dollar estimate. His neighbor, however, points out that solvent cements are sold *wet*. So he comes up with a gallon figure and a representative dollar figure based upon the sale of a finished adhesive.

A market analyst investigating the adhesives market for a client now has several figures to work with. What does he do? Often, he adds them together. The really sophisticated ones among us may even make a survey of all the mixing vessels available in the United States; add up all the solvent cements that could be mixed; take into account an eight-hour work day (with an hour off for lunch); and then arrive at a total sales figure. The odd thing about it is that this last gentleman may be closer to the truth than his neighbors.

Well, we are all in the same boat. Perhaps one way to solve the dilemma would be to study astrology. A more likely way would be to come to some agreement among ourselves. When quoting figures relating to consumption of one type of adhesive or another, why don't we all talk about *compounded* adhesives. In this way, when we quote a figure involving the sale of solvent cements we will all be talking of cements which are sold ready for use. Or, let us agree to talk only about dry content. One way, the other way or a third way, we must come to some meeting of the minds. For while some of us see new business, some of us see confusion. Let us all see reality. We welcome comments and suggestions from our readers.

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CONSULTANT'S CORNER

By Dr. Arthur Hirsch
(Guest Columnist)

Flatter Labels and Tapes

The elimination of curl from label stock and gummed tape has been the subject of extensive research throughout the years. It has led to the issuance of several patents, some of which have resulted in prolonged litigations.

Curl is one of the inherent properties of remoistenable adhesive coatings formulated with animal glue or starch products. By "curl" is meant the tendency of a "flat" coated sheet (or tape) to curve. Its edges are drawn inward. This happens especially after prolonged exposure to a dry atmosphere.

There are several basically different methods to minimize this undesirable feature:

Breaking—Since the surface of the glue or starch film contracts (or expands) with changes in humidity, it was felt that conversion of this surface into small independent islands of film bits could overcome curl. Each island would contract on its own without exerting a force on the neighboring island. The surface of the label or tape would thus remain relatively flat. In order to "break" the coating into these several microscopic independent units, the coated sheet was passed over a sharp edge, fractioning the solid glue film into an infinite number of independent islands.

Several refinements have since been introduced. For instance, instead of a single sharp edge, paper may be passed over two edges, each at a 45° angle to the paper and at 90° to each other. The diamond pattern thus produced is said to give a minimum of curl. More recently the diamond pattern has been combined with the straight break to yield an even better "three way" break.

Since sharp edges have a tendency to wear and require frequent, costly and time consuming replacements, a variety of devices have been investigated for use as breaker bars. The most interesting development along this line, however, might be the introduction of compressed air as a breaking medium in place of the conventional steel bar.

But breaking is at best a stopgap measure. It is a costly operation, requiring special machinery and extra handling of materials, and causing un-

told waste. The relief it yields is only temporary. This is especially true with a starch tape or label where there is a tendency of the wounded adhesive layer to heal into a continuous film.

Chemical Means—Attempts to incorporate plasticizers, chemicals which will retain the adhesive film in a flexible state, have met with only partial success. The only good plasticizer in common use in animal glue and starch-based adhesives is water. The adhesive formulator employs humectants such as glycerine, sorbitol, urea, etc. to retain a desired level of humidity within the "dry" adhesive film. However, even the best humectant is dependent on environmental humidity conditions. It is thus unable to either keep the adhesive layer from drying out and consequently curling if exposed to dry air for prolonged periods or prevent it from blocking upon excessive contact with a highly humid atmosphere.

New Formulations — Several patents of recent date have approached this problem from a new angle. Instead of producing continuous film and thereafter fracturing same by means of breaker bars, these inventors have decided to produce a discontinuous film in the first place. If curl is caused by forces that adjacent glue or starch particles exert on one another, it would be best to separate them. Thus finely ground glue or starch particles are dispersed in a resin binder and coated on the paper from a solvent solution. The resin binder is usually present in a small proportion only (not more than twenty per cent of total solids) and may be chosen from film formers such as PVM or PVAc.

There seems to be some disagreement as to whether this resin must be water- as well as solvent-soluble. Upon evaporation of solvent, there remains a coating of distinct particles of animal glue or starch bonded to each other and the paper by resin. This coating is water-remoistenable but does not curl. One of the major difficulties encountered in the preparation of this type of coating, however, is associated with the requisite fine particle size of the animal glue or starch.

New Coating Method—A recently disclosed new method of coating paper achieves results comparable to the above new formulation. This new method employs a resin and a finely granulated animal glue or starch as well. The solvent is, however, completely eliminated. Instead of coating a resin glue solution, this new machine deposits an electrically charged powder cloud upon the paper. The electric charges afford both temporary anchorage and control of the quantity of coating. The resinous binder is thereafter activated by heat or solvent vapors to form a permanent bond. Upon removal of the excess charges the paper is ready for rewind and further processing.

The variety of new processes may not all be equally economical. But one thing is certain: the consumer can look forward to flatter flats.

Dr. Hirsch is an associate of Skeist Laboratories, Inc., Newark, N.J. He has been in the adhesives field for over ten years.

Now when you want to bond different plastisols to metal, glass, ceramics and certain plastics, you no longer need a special primer for each. Use versatile PLIOGRIP 22-4 and you'll cut way down on the number of primers to stock–simplify purchasing–reduce the chance of misapplication.

Besides versatility, PLIOGRIP 22-4 gives you good adhesion under heat aging, water immersion, elongation and stress. And it's easy to handle–applies by spraying, brushing, dipping or other conventional means–air-dries–activates at 350°F.

PLIOGRIP 22-4 is just one of the large–and growing–family of outstanding Goodyear primers, adhesives, sealers, coatings and caulking compounds designed to meet a wide range of needs. Write Goodyear, Chemical Division, Dept. F-9466, Akron 16, Ohio.

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CHEMICAL DIVISION

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new adhesives
AND ADHESIVE PRODUCTS

Three Adhesive Tapes

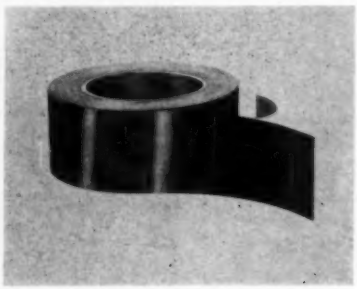
Three gray cloth, pressure-sensitive adhesives tapes are announced for industrial applications. C-518 Plain Cloth Tape is .0125 inches thick and has a tensile strength of 50 pounds per inch width. Its adhesion to panel is 45 ounces per inch width and adhesion to backing is 40 ounces. A dull finish on the cloth backing makes it suitable for applications requiring low gloss. C-519 Coated Cloth Tape is a waterproof product with a .013-inch thickness. Its adhesion to panel is 45 ounces per inch width and adhesion to backing is 30 ounces. The tape has a tensile strength of 50 pounds per inch width. C-520, another waterproof tape, has a polyethylene-coated cloth backing. It is 14 mils thick and has a 40 ounce per inch width adhesion to steel and a 35 ounce adhesion to backing. Its tensile strength is 45 pounds per inch width. *Arno Adhesive Tapes, Inc.* **P-497**

Synthetic Rubber Adhesive

Parts may be assembled within two to five minutes after the application of Bostik 1142, a fast-drying, synthetic rubber adhesive. The compound is said to be particularly effective for bonding porous materials, such as urethane foam, to metal. It is also recommended by the manufacturer for bonding to steel, brass, glass, neoprene, butadiene-styrene, nitrile rubber, phenolic, urea, polystyrene, fiberglass felt, cork, masonite, leather, nylon, sponge urethane, sponge rubber and enameled surfaces. Directions for use allow three application methods: two-way dry stick, two-way wet stick and two-way solvent activation. The adhesive is a pinkish tan and has a 28 to 30 per cent by weight solids content. Bostik solvent or MEK may be used as thinning agents. *B. B. Chemical Co.* **P-498**

Polyethylene Tape

A new pressure-sensitive polyethylene tape announced is said to provide effective performance throughout a temperature range of —50°F. to 225°F. The tape is



stretchable and will conform to most variations of surfaces and contours to which it is applied. The adhesive will not separate from the four-mil polyethylene film surface even when stuck to itself and then pulled apart. A release paper backing allows easier handling and application, especially in pre-cut strips or patches. *Fasson Products.* **P-499**

Clear Epoxy

Clear, transparent bonds for cementing glass and ceramic parts are available with Rez-N-Glue EP-F. The epoxy formulation begins to cure within 20 minutes and after a half hour the resin jells to the point where it can no longer be used as an adhesive. The adhesive is formed by two components which are mixed in equal parts. Blending forms a free flowing resin that is readily dispensed from paper cups or other convenient containers. Bonds cure fully at room temperature in 24 hours. *Schwartz Chemical Co., Inc.* **P-500**

FOR MORE INFORMATION on these new products use the Readers Service Coupon in this issue.

CA-25 Contact Cement

A new general purpose industrial adhesive designated as CA-25 Contact Cement has been found successful for bonding plastic laminates to wood, metal, plastic or glass surfaces. Equally outstanding performance is claimed for the new product in bonding metal trim to wood, metal or masonry surfaces.

CA-25 is described as a synthetic rubber base solvent type adhesive of excellent tack, forming an immediate and permanent bond of exceptional strength without the need of sustained pressure from clamps or presses. CA-25 is easily applied with simple, readily available equipment; the adhesive strength is obtained without the use of heat, and the permanent bond improves with age, it is said. Moreover, the bond is flexible and thus will withstand constant or variable stresses, impact and vibration, as well as expansion and contraction caused by rapid temperature changes, the manufacturer adds. Supplied at a consistency suitable for brush, comb, or machine roller application, CA-25 gives coverage of approximately 150 square feet per gallon (brush application, medium coat), and has shelf life of one year or more.

Water-proof, alcohol-, alkali-, rot-, and fungus-proof, the product is also highly resistant to many acids and is not attacked by insects, rats, mice or other vermin. Test bondings of plastic laminates to plywood with CA-25 in 1 square inch lap joint, aged 96 hours at room temperature, resulted in adhesion strength of 525 pounds per square inch. Outstanding ratings are also attributed to CA-25 Contact Cement in wet bond, boiling water, and dry heat shear strength tests. *Miracle Adhesives Corp.* **P-501**

Anodized P-S Tabs

Serially numbered, pressure-sensitive, anodized aluminum foil marker strips in a comb-shaped dispenser are now available for fast serial identification. The adhesive back holds the markers in place without the need for drilling, tapping, screws or pins. Any combination of letters and/or digits can be furnished. *North Shore Nameplate.* **P-502**

What's News in Rubber...

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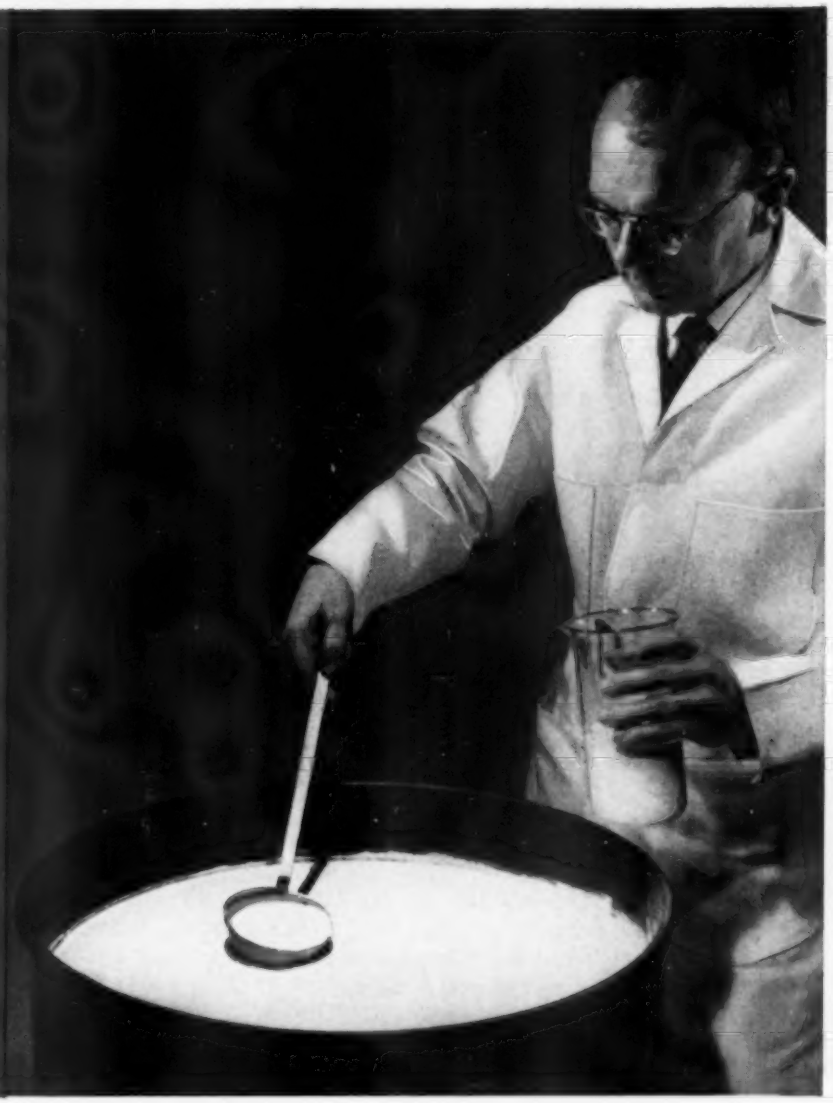

Now you can get Butyl Rubber in convenient latex form – an easy-to-handle emulsion that has all the outstanding properties of Butyl!

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Enjay Butyl Latex is shipped FOB Baton Rouge, La. in phenolic-lined, insulated 8,000 and 10,000-gallon tank cars, or in lined 55-gallon open-head steel drums. Drum stocks will be warehoused at other strategic shipping points in accordance with demand.

For more information and your copy of our Latex manual, write to Enjay at 15 West 51st Street, New York 19, New York.

TYPICAL INSPECTION DATA	
Total Solids, wt %	55
Specific Gravity, 70°F	0.96
pH	5.0
Viscosity, cps	560
Mechanical Stability	Excellent
Freeze-Thaw Stability	Excellent
Chemical Stability	Excellent

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THE BUSINESS UPTURN IS NOW PICKING UP SPEED. You can see this quite clearly in steel and auto output, industrial production generally, new home starts, and consumer incomes. By the end of the second quarter, total output of goods and services will be up measurably from the start-of-the-year low. Economists think the improvement will add $10 billion to the rate of output.

> The rate of recovery will accelerate in the second half--with step-ups in hiring, consumer buying, business investment, and government spending. Conservative estimates put the gains in total output in the second half at another $15 billion. A growing minority, though, expects more--maybe $25 billion.

THE RECOVERY WILL DEVELOP INTO A FULL-SCALE BOOM IN 1962 even if the more conservative estimate for the next six months is the one proving out. This year's gains will generate the preliminary momentum. Currently rising sales will soon be clearing out inventory and encouraging plant expansion. And rising incomes will prepare the stage for a spurt in consumer spending.

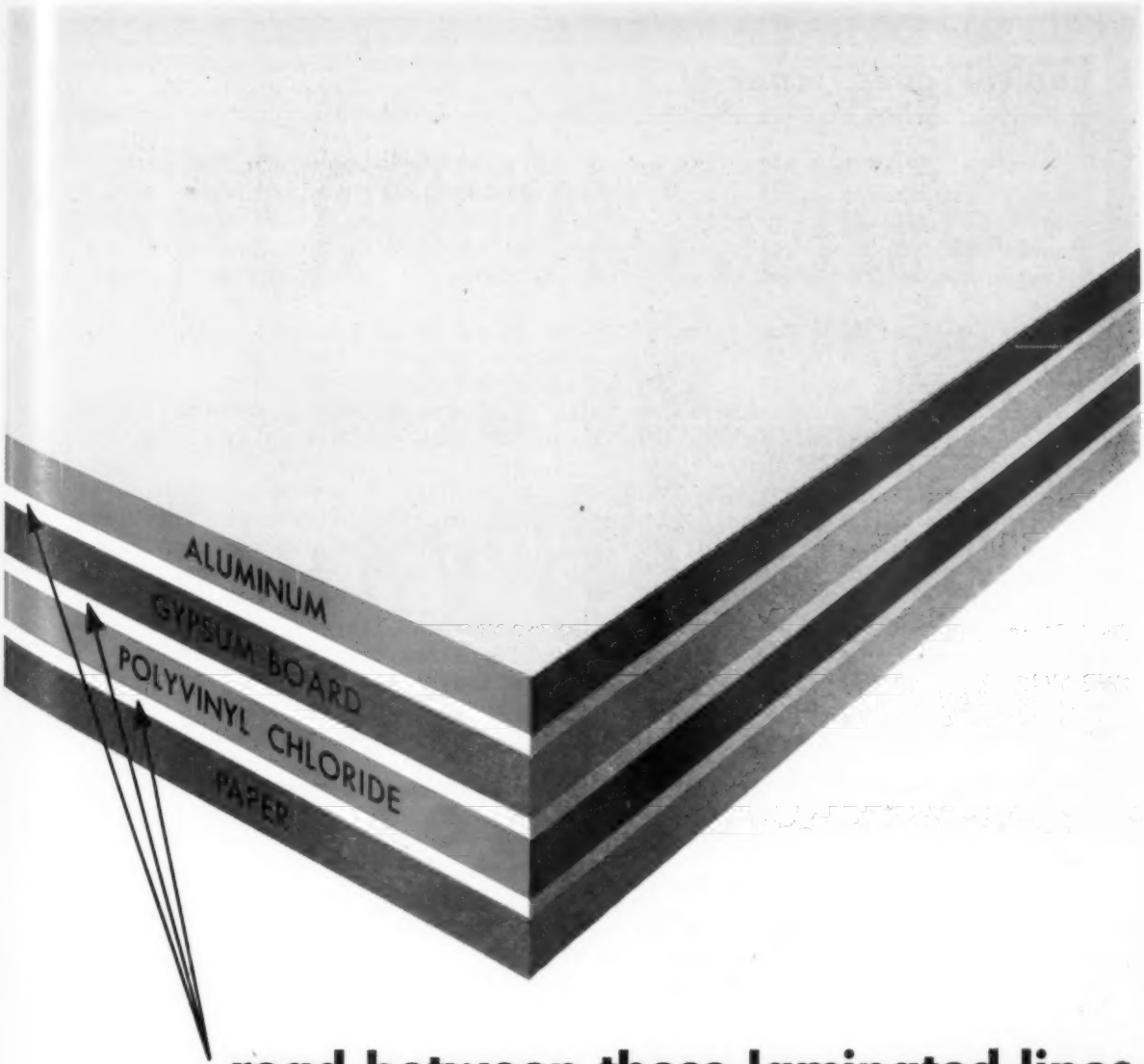
> Much of the push next year will come from consumer purchases of durable goods--autos, appliances, furniture, and homes. This has been a slack area for several years now. But the need to replace so many items and the formation of many new families will swell demand. Further, people are upgrading their desires--two cars, air conditioning, color TV sets.

BUSINESS ABROAD IS ALREADY BOOMING, in contrast to the slack here. Industrial output is high and still rising. Unemployment is generally low. Exports are strong. Things are so good that inflation is a potent threat. Canada is about the only major exception to this trend. It is closely tied to U.S. developments. The number of jobless is high, while output is down.

> Essentially, the booming times are a world-wide phenomenon.
> -In Europe, business is rolling in France, West Germany, Italy, and Holland. British output is high, but exports are off.
> -In Latin America, business is up in Argentina, Mexico, Peru.
> -In the Far East, the Japanese are making prodigous gains. India and Pakistan are gaining in agriculture and industry.

CORPORATE PROFITS ARE TURNING UP this quarter, according to early reports. Company nets will look much better than those of January-March. There are two reasons for this outlook. One is improved sales prospects. The other is the progress that many companies have made in slashing costs.

> First tabulations show that most lines suffered substantial declines from 1960 during the opening quarter of this year.
> -Increases were racked up by utilities, finance and banking, petroleum, office equipment, and non-rail transportation.
> -Declines were registered in chemicals, coal, drugs, steel, paper, railroads, autos, machinery, and building materials.



read between these laminated lines

...and you will learn a very significant fact: the adhesive is based on GELVA Emulsion TS-100, a vinyl acetate-acrylate copolymer that provides an outstanding combination of adhesive properties.

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capitol cues (cont'd)

PRICES OF RAW MATERIALS ARE ON THE RISE these days, for the most part in response to improving business. Prices will be up 2%, over-all, by year-end. But the gains will vary considerably, from line to line. In some cases, the increases will be slow to start--showing up, to begin with, in disappearance of special concessions. (This may be what happens in steel.)

-Metals: Look for gains of 1% to 1½% as production goes up.
-Scrap: Rising metal output--and exports--will lift costs 5%.
-Lumber: There'll be hikes of 4-5%; inventories are down.
-Other building materials: Gains averaging 2½% are foreseen.
-Farm products: Prices this Summer will be up 1% over 1960.

CONGRESS WILL REWRITE KENNEDY'S TAX PROGRAM this year to fashion it along lines that business would prefer. Congressional tax experts believe some key items will be killed outright. Others will be altered considerably. Indeed, the changes may be so sweeping that the President will veto the bill.

Liberalized depreciation to spur investment, is the core of Kennedy's program. He wants to allow a tax credit to firms that step up capital spending. But industry wants formulas that give a break to all--not just those that lift outlay. And Congress seems certain to endorse the latter approach.

The outlook for other key sections of Kennedy's tax program:
-Repealing the dividend credit: This one is considered too touchy, politically, to get through the House or Senate.
-Withholding taxes on dividends: There's little controversy over this one, but it will pass only as part of a big bill.
-Taxing foreign income as earned: Congress will refuse to end the deferral of taxes on income kept abroad by U.S. firms.
-Cracking down on expense accounts: There's little objection but lawmakers doubt whether workable rules can be drafted.

YOU MAY SEE SOME TOUGH LABOR NEGOTIATIONS this year, say government labor experts. They expect union demands to stiffen as compared with 1960. With one eye on the recovery, union leaders want to make up for lost time. But, with improvement only starting, industry can't pay big benefit hikes. Many firms say they will take a strike before they let labor costs inflate. Autos, railroads, farm equipment, and meatpacking will be key trend-setters.

Unions are now counting on better breaks from the National Labor Relations Board. For one thing, Kennedy has made two appointments which give the Democrats a majority; the new men are fair but "friendly." For another thing, some recent Supreme Court decisions clipped the Board's powers in cases involving union activity aimed at forcing workers to join.

SMALL FIRMS WILL GET MORE PENTAGON BUSINESS under a program that's being drafted by Defense Secretary McNamara. He hopes to earmark a bigger share of the rising arms budget for companies of eligible size. Altogether, nearly a half-billion dollars more in contracts will be set aside. Quotas are being specified for each service and procurement unit. Procurement officers are being told to keep an eye out for new opportunities for small outfits. Prime contractors are being pressed to give more work to smalls.

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• **Adhesives At Plastics Meeting In West Berlin.** The German Association of Plastics held its ninth meeting from April 12th to 14th in West Berlin. Among the many papers offered, were the following dealing with adhesives: Dr. Rudolf Koehler, Duesseldorf, discussed the physics of bonding; Josef Eilers, Aachen, presented a paper dealing with joining of plastics by means of bonding.

Europe is paying more and more attention to the application of adhesives in various fields. In view of the fact that the European Common Market represents a potential outlet for 180 million people, it would be interesting for every American manufacturer to at least investigate the business possibilities which present themselves in Europe right now. Many European factories are most eager to team up with American know-how, and every day more agreements are concluded for joint development of the European market. A visit to the nearest field office of the U.S. Department of Commerce will give you all the information you need to get started.

• **Metal Bonding.** In our March issue we reviewed an Austrian booklet entitled "Metal Bonding" and pointed out that only three companies are mentioned as American sources of supply. The editors of the booklet have since stated in a letter to this column that prior to publication they contacted a number of American adhesives manufacturers requesting leaflets and other information. Unfortunately, only a few companies responded. However, the editors are still very much interested in having on hand a complete list of all important manufacturers of adhesives. They would also like to have information as to Austrian representatives of American firms.

We suggest that every manufacturer of adhesives which can be used for metal bonding put his leaflets and literature in an envelope, mail it to Handwerkstechnisches Institut, Bauernmarkt 13, Vienna 1, Austria. To establish contact with suitable representatives in Austria, write to the nearest field office of the U.S. Department of Commerce. Better still, call your field office personally so that you can speak to the particular specialist for the European country.

A few days ago, we had a lengthy discussion with a German industrialist who came to the United States to visit the packaging show in Chicago. Before sailing he expressed his astonishment as to how little is known in Europe about the startlingly new American adhesives he discovered in Chicago and in other cities he visited. He emphasized that some of the products would have a very great future on the European market. A small effort on the part of the American manufacturers could really open up very rewarding business contacts.

• **Adhesives For High Temperatures.** A new series of resin compounds, which are said to possess an exceptionally high bond strength has been developed for joining together dissimilar materials, according to the London *Financial Times*, of April 12. The new resins are claimed to have an exceptionally good ability to resist high temperatures. Bonds produced with the material are said to hold completely firm at temperatures of from 500° to 700°F. This means that they can be used, for example, to glue ovens together. At the same time it enables metal parts to be glued together in applications which would otherwise have required welding. Development work on the new polymers is continuing, and they are expected to find widespread applications not only in aircraft production, but also in general industrial, mechanical engineering.

• **Latex Cuts Packaging Costs.** A very interesting application of latex for packaging purposes is described in a recent issue of *Rubber Journal and International Plastics*. By coating one side of a recently introduced resilient packaging material —called Carbion—with a latex solution, a new system of packing has been developed. Carbion itself consists of strawpaper or a similar base passed through heated profiled pressure rolls which impart a characteristic double-wave pattern to it. The addition of a latex coating in many cases eliminates the need for other means of fastening. Standard commercial latex is used, which is applied by rollers, after which the material is force-dried, cooled and reeled. This special process has been developed by an English company which makes and markets the material.

The main application is the protection of small parts. Much time and labor is often spent on packing spare parts, accessories, small tools and similar items. These are now merely placed on a piece of self-adhesive Carbion of appropriate size. The

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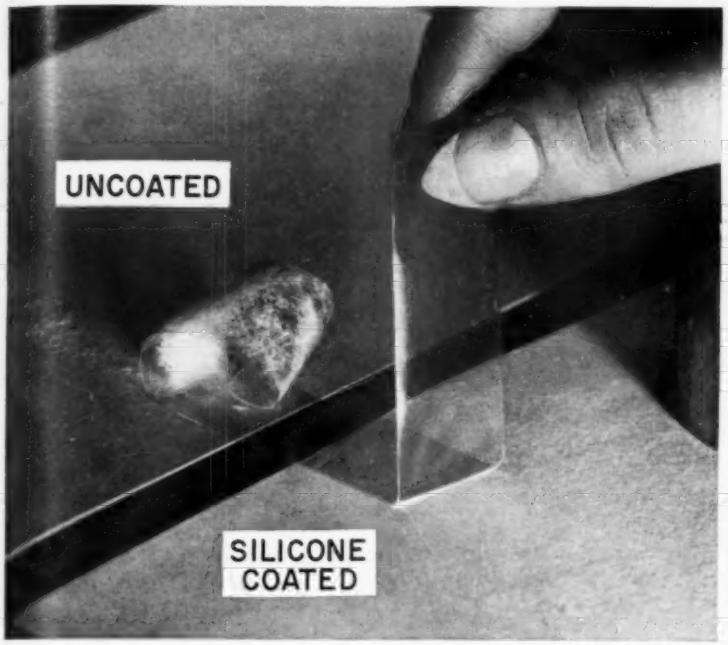

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piece is folded over and firmly pressed down along the edges and around the enclosed parts which are immediately held securely in an envelope of convenient shape. To remove the parts, the seal is pulled apart. The material can be used several times. The latex does not adhere any surface which does not also have a coating of latex.

Larger parts can be packed by placing them between separate sheets of the material, while irregularly shaped items are protected by folding the material over them and pinching the folds so formed together. Tubular products, which have hitherto required the use of time-wasting spiral wrapping, can now be protected better in a fraction of the time formerly required.

• **Ready-Mixed Epoxy Adhesives.** The addition of a latent hardener to an epoxy resin adhesive is said to eliminate mixing at the time of use and to give shear strengths of over 2500 pounds per square inch in metal-to-metal bonds, according to *Financial Times*, London. This strength is maintained over a range from —67° to 300°F., the makers claim, and the adhesive meets military specifications. Only contact pressure is required during curing which takes place in an hour at 300°F.

• **Czechoslovakian Adhesives for Metal Bonding.** *Plaste und Kautschuk*, the East German trade paper for the plastic industry features in its January issue an elaborate presentation of research and development work on Czechoslovakian adhesives for metal bonding. The material is based upon work at the aeronautical research and testing installation at Letnany near Prague. It is pointed out that a number of adhesives for metal bonding are manufactured in Czechoslovakia, but that satisfactory testing methods have not been developed. In recent years, there has been research on metal bonding in the airplane industry and some results are available in the article. Interestingly enough the testing methods which have been adopted are the American ASTM standards, so that results can be compared with those published in the international literature. Araldite I powder, manufactured by CIBA AG, has been selected for comparison with the Czechoslovakian adhesives. Several Czechoslovakian makes have been tested: Epoxies No. 1, 2, 3, and 110 of Laboratorium VUSPL in Pardubice; the Epoxies No. 1001, 110, 1200 produced by Verband Usti n/L, and finally No. 6288 made by the Matador plant in Bratislava.

The author is not very talkative about the results. He refers to the various charts and points out that some of the results achieved with Czechoslovakian adhesives were almost similar to those of Araldite I powder. Without giving any additional details, another chart enumerates a number of adhesives which have been used for comparison purposes. Since the results apparently astonished the researcher, no further credit to these has been given. Here is a list of the test adhesives: PA 101, Epon VI and VII, Metlbond MNZC and No. 4021, FM 47, Redux E, Cycleweld C 3, 55-10 and Plastilock 601.

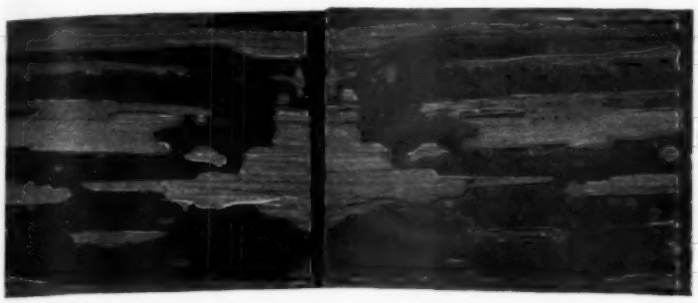
• **PVC Coating For Foams.** A process for coating polyvinyl chloride to cellular materials by a two-coating system has been patented by Rene Droessaert in France. The undercoating is produced from a solution of a copolymer of vinyl acetate and vinyl chloride which also contains maleic acid, titanium dioxides and methyl isobutyl ketone. The top coating is produced from an organosol with a base of PVC and one or more plasticizers, pigments, stabilizers and dispersion vehicles. The coating is sumbitted to gelation at 302° to 320°F.

• **Adhesives For Underwater Application.** A number of European newspapers have recently published items dealing with adhesives for underwater applications. They reported that for repairs or bonding of metal parts or ceramic materials submerged in water, a new adhesive can be used which will harden or cure under water. The basis of this new adhesive is a mixture of an epoxy resin. A catalyst added shortly before application effects the cure.

• **Radiation Resistant Adhesive.** Nuclear developments require adhesives which are radiation resistant. Measuring and control instruments are required in work with radioactive isotopes which have been assembled with adhesives. In order to stand up under continuous use the adhesives have to be immune to radiation. A Swiss company has reportedly succeeded in developing such an adhesive based upon certain vinyl resins.

• **Austria Will Produce 20,000 Tons Of Plastic Foil.** Semperit, the well-known Austrian tire and rubber goods factory, and Schmiedberger, the chemical factory, have decided to join forces and build a factory in Wels, Austria, for the production of plastic foil. Called Interplastik Werk AG, this company will have a capital of about $2,000,000. It will go on stream within three years and will produce plastic foil of all kinds.

NEW RESIN MAKES NEOPRENE ADHESIVES TOUGHER...EASIER!



Laminated plastic panel forced from fir plywood by hammer and chisel 48 hours after cementing with formula including SHANCO #740. Note high percentage of wood grain failure compared with adhesion to plastic.

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By RICHARD F. BLOMQUIST
Chemist
Forest Products Laboratory, Forest Service
U.S. Department of Agriculture
Madison, Wisconsin

Adhesives for the Future of the Wood Industry

New wood adhesives and bonding techniques will have to take into consideration the fact that while our national timber supply has been cut drastically the demand for wood products continues to rise

In order to consider adequately the future of adhesives in the wood industry, we need to know some facts about what this industry is like today, and what it may be like tomorrow. One of the most important factors determining the nature of the wood industry is the quality of the timber available to it.

When the early settlers came to America 300 years ago, they found timber in abundance for all of their needs. They found beautiful stands of white pine suitable for building and for ship construction. They found fine maple and walnut for furniture. Yellow poplar and basswood were available in large size, suitable for making boards for intermediate uses, such as cabinets. The white pine stands of the Lake States, prime for the harvest in 1890, were ideally suited and situated to supply the building material for thousands of homes in farm and city in the Midwest Prairie States. Dowels, nails, and a small pot of animal glue were adequate fasteners for joining the materials of the day into the simple structures and assemblies required.

More recently, the lumber industry turned to the South, and the famous "Arkansas soft pine" had its day. Southern pine lumber is still important, but the large pieces are scarce, and most wood is now cut from smaller second-growth trees. Later, the West Coast wood-using industry developed, thriving primarily on an abundance of slow-grown, large-sized, soft-textured Douglas fir. Large, clear boards were readily available. Plywood panels, four by eight feet in size, without a flaw in them, were the common material on which the West Coast plywood industry built its reputation.

Our Timber Supply

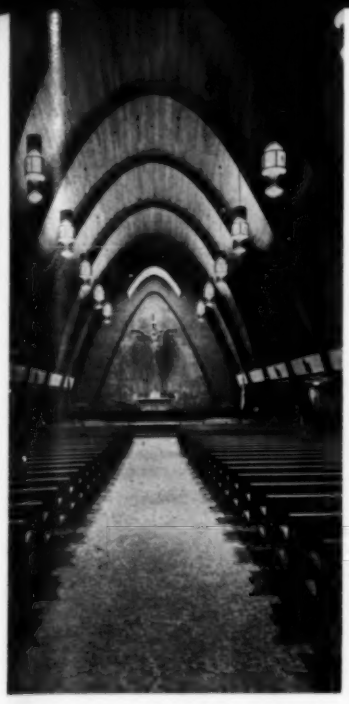
Now, in the middle of the 20th century, the timber supply situation is drastically different. High-quality, readily accessible, virgin timber supplies are fast becoming all but unavailable.

The Timber Resource Review, released in 1958 by the U.S. Forest Service, predicts that the demand for wood in 1975 is likely to be 25 to 40 percent greater than it was in 1950; and in the year 2000, perhaps twice as great.

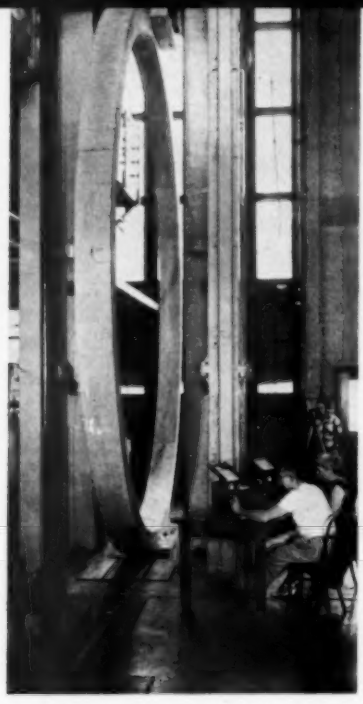
State and federal agencies and private industry are doing a commendable job of reforesting their cut-over lands. They are generally practicing good forest management, putting the land on a sustained-yield basis, and making greater efforts to protect the trees from fire and insect damage. This will improve our timber supply in years to come, but it will not equal the earlier virgin stands during our lifetime, if ever. Proper utilization of our timber supply is vital to us all since trees are one of our very few renewable natural resources, especially for structural uses.

Whether the wood-using industry will have enough wood to maintain its rightful place in America's economy will depend in part on whether we can stretch our timber supplies farther through closer and better utilization. It will also depend on whether ways can be found to use the kind and quality of timber that will be available for harvest during the coming years.

On the nationwide scene, timber quality is declining. In the East, about 40 per cent of the volume of hardwood saw timber and nearly 70 per cent of the softwood timber volume is in trees 15 inches in diameter or less. Only ten per cent of the eastern hardwood timber is high-grade material, while 54 per cent is low grade, and 20 per cent of the total is in the form of cull trees.



A dramatic use of laminated structural wood is shown in St. Bernard's Catholic Church, Middleton, Wisconsin.



Careful testing has permitted important advances in wood laminating. (Photographs courtesy of Unit Structures, Inc.)

Glued-laminated members provide the framework of this wooden minesweeper shown in launching position.

In the West, where most of our timber comes from today, we are cutting timber about twice as fast as we are growing it. The second-growth timber now attaining usable size is far inferior in quality to the former timber.

These facts can lead only to the conclusion that our lumber, our large timbers, and our wood paneling materials will inevitably be in the form of glued products—put together out of many small pieces of wood and bonded with adhesives to form materials of the size and quality needed for tomorrow's products.

Wood formerly wasted must also be used. In 1952, waste wood was estimated at 1.4 billion cubic feet of log residues and 3.4 billion cubic feet of plant or manufacturing residues. Much of this wood will be used (and is already being used) for the manufacture of pulp and chemical products. It is likely, however, that such wood residues will also supply raw material for panels and molded products, thus replacing some of the other wood products now made of lumber and plywood. Adhesives are the key to this form of utilization.

Modern adhesives and bonding techniques already play a vital part in the wood industry. Gluing makes it possible to produce wood members superior to those now generally available without gluing. Glues enable us to combine wood of various grades and species into products that do not occur in nature. Wood can also be combined with other materials, including wood-base materials, such as paper, hardboards, and particle board, to produce entirely new products in the form of composites of several different materials. Thus, the competitive position of wood is enhanced with respect to steel, plastics, and other materials.

New Production Opportunities

The opportunity now exists to produce engineered products of wood by bonding pieces together in various patterns and orientations, such as glued structural members of lumber and plywood. It is difficult to imagine any significant new wood products that do not in one form or another incorporate adhesives in their manufacture.

We recognize, of course, that lumber, the principal wood product that accounts for well over half of the timber used today, is still made largely without benefit of gluing. In 1958, almost 34 billion board feet of lumber were produced in the United States. nearly 80 per cent of softwoods. One estimate indicated that as much as 2.5 per cent of this softwood lumber involved some type of gluing in manufacture or use.

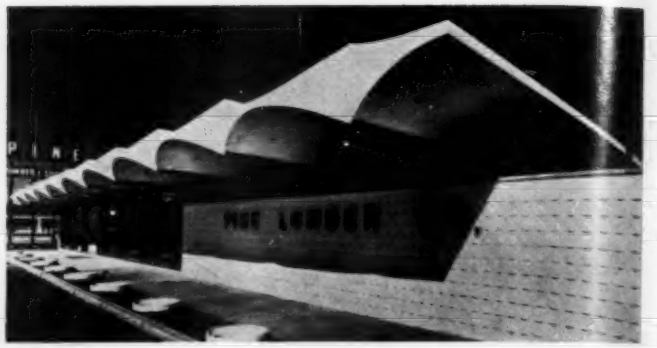
Up until now, the sawmill operator has done no gluing. Such gluing and further processing has been carried on by secondary processors. The lumber producer, however, will very likely want to glue up his smaller pieces in the near future to utilize better his available raw material. This will mean the introduction of entirely new gluing equipment to the sawmill. Here, the simpler the gluing process, the more rapidly it will be accepted and used.

One of the largest markets for lumber, particularly softwood lumber, is in home construction. The availability and easy working properties of lumber have made it the most convenient construction material for the average small builder. Most of the labor involved in building a house is applied on the site. Yet, builders tell us that the house of tomorrow will be largely set together on the site from components made in a factory. These

Fabrication of 150-foot plywood box beams by nail gluing on the site, bottom photograph. The beams will be supported on 50-foot spans for a roof.

Curved roof of plywood glued to lumber frames. The spans are 40 feet with eight-foot overhangs. (Photo courtesy of Douglas Fir Plywood Association)

Prefabs, bottom right, built by the U.S. Forest Products Laboratory in 1937 as part of research on stressed-cover wood and plywood construction.



components will be preassembled modular sections of houses, put together out of materials that lend themselves to factory assembly.

Principles now applied in component construction were demonstrated at the U.S. Forest Products Laboratory 23 years ago in the first stressed-skin panel houses to be built experimentally in this country *(1)*. Today, sufficient information is available for the production of modular glued components that incorporate interior wall surfaces, framing members, insulating material, and exterior skin and surfacing material of wood products put together with adhesives. Largely through the use of glues, the lumber and the plywood industries will find it possible, if they so desire, to retain a large part of the housing market which may otherwise be taken over by competitive materials, such as metals, glass, and plastics.

The magnitude of the market available for glued products in the housing field may be estimated from the fact that 1,200,000 dwelling units were started in the United States in 1958, with an estimated three million units to be built annually by the year 2000.

In 1900, only animal glues were available for gluing wood. The first practical starch glue was introduced in 1903, and at that time was widely used for the gluing of hardwood plywood for furniture. During World War I, the development of the first practical water-resistant casein and blood glues took place largely under the accelerated development program in connection with wood aircraft for military uses. In the early 1920's, soybean glues were first developed for interior-type plywood on the West Coast.

New Glues Introduced

In the early 1930's, the first phenol-resin glues were introduced into this country from Germany, followed shortly by the urea-resin glues for wood. Late in the 1930's came the introduction of melamine-resin glue, which found a somewhat limited application in the hardwood plywood field. In 1943, the first practical resorcinol-resin glues came into existence, just in time to find very important uses in wooden aircraft and in the laminated ship timbers so necessary in World War II.

About 1945, the first polyvinyl-resin emulsion woodworking glues were marketed, which was an opportune time because of the shortage of animal glue and the greatly increased production of civilian furniture. The principal uses and limitations of present wood adhesives are shown in Table I.

Thus, by 1945, we had available all of the present conventional types of woodworking glues, although much remained to be done to establish the best production techniques, particularly for the use of resorcinol- and phenol-resorcinol-resin modifications, and the polyvinyl-resin emulsion glues in woodwork. The introduction of each of the synthetic-resin glues into the wood industry to replace older non-resin types met with varying degrees of resistance. Some of them, in fact, reached their first large-scale use in wood gluing under wartime contracts where their use

was required by the military agencies. Extensive research and development work accomplished during the war played an important part in the successful application of these glues in the civilian woodworking industry after the war.

A good example of the wide utilization of glue to make a better product out of wood is afforded by the plywood industry. In 1959, the softwood plywood industry in the Pacific Northwest produced approximately 7.7 billion square feet of plywood on the 3/8-inch-thickness basis. It is estimated that this operation required 185 million pounds of dry glues of various types.

Industry Changes

The softwood plywood industry, primarily using Douglas fir, is continually growing and changing. In recent years, more of its production has been going into sheathing for walls, roofs, and floors in housing, where the plywood is used as a structural material and must retain its integrity for many years. This has resulted in a growing intolerance of minimum-quality glue bonds, which assumed that shingles, siding, and finish flooring will completely protect the glue lines of the sheathing in use, and is causing a gradual upgrading of plywood glue quality.

The Douglas fir plywood industry started out as rather small plants that used cold-pressed soybean glues and made only interior-type glue lines. Soon hot presses were introduced to utilize the hot-setting phenol resins for exterior-type plywood. It was not long before new soybean-blood blends were used as hot-press glues for interior use, thus speeding up production and reducing labor involved in cold pressing.

Recently, a variety of interior-type glues of phenol resins extended with either dry blood, ground bark powder, or with a lignin-like residue from the hydrolysis reaction to produce furfural were introduced for hot pressing interior-type plywood. This industry is certainly production minded. It is continually considering new techniques to provide more economical production of high-quality plywood for both mild and extreme service.

Under consideration are such novel developments as automatic core-laying techniques, automatic spraying of the adhesive, spreading of foamed glues, and the use of dry- or wet-film adhesives (*2*). Such new developments would make possible the more complete automation of the layup process, the elimination of much labor, a reduction of wastage of both veneer and glue, more uniform glue spreads, and more uniformly good glue joints.

Because of the more extensive use of plywood in housing and other long-term uses, the softwood-plywood industry is thinking more seriously of the ultimate production of only exterior-type plywood. This change is not likely to occur suddenly, but the shift towards a larger proportion of exterior glue line will no doubt continue steadily. This line of thought has already spurred the expansion of plant facilities for phenol on the West Coast (*3*). The requirements for glue joint performance in Douglas fir plywood are thoroughly presented in Commercial Standard CS 45-60 (*4*).

United States Production

In 1958, about 792 million square feet of hardwood plywood were produced in the United States. This material was made primarily with urea-resin glues, either in a hot press or by cold pressing, often extended with varying proportions of wheat flour. Consumption of hardwood plywood in 1958 was nearly twice production, with the difference made up by extensive foreign imports. A glue bond corresponding to the exterior type of softwood plywood and more durable than this urea-bonded material is commonly made with a melamine-urea resin glue in a hot press. The amount of this more durable hardwood plywood is rather small, since nearly all hardwood plywood is used for furniture, architectural paneling, doors, and other strictly inside applications. Glue joint requirements for hardwood plywood are prescribed in Commercial Standard CS 35-56 (*5*).

In contrast to plywood, which is made by gluing sheets of thin veneer with the grain of the wood at right angles in adjacent plies, laminated wood consists of several rather long and narrow lengths of lumber (commonly one to two inches thick) glued together with the grain of all plies parallel. Although laminated timbers have been used to some extent in buildings in Europe for several decades, the manufacture and use of such timbers in this country dates largely from World War II.

Industry's Rapid Growth

According to the 1954 census of manufacturers, the laminating industry produced nearly 46 million board feet of glued laminated material, with a value exceeding 13 million dollars. This industry has grown rapidly in the last few years. Current estimates of the production of glued-laminated wood products run as high as 150 million board feet annually. The bulk of this was in custom-designed curved or straight members for churches, field houses, supermarkets, factory buildings, and schools. It is estimated that the laminating industry alone uses five million pounds of glue, computed on a dry basis, each year.

The types of adhesives primarily used are the resorcinol and the phenol-resorcinol resin glues for outdoor service, such as ship and bridge timbers and utility pole crossarms, and the casein glue for interior laminates. At present, most of the production is with casein glues. The industry would welcome the development of new glues for exterior service that will cure at normal shop temperatures, which may often fall below the 70°F. lower limit currently recommended for the resorcinol-type glues.

The gluing problems of the laminating industry are quite different from those of the plywood industry because of the large sizes of lumber being glued and the equipment currently available for surfacing the wood, spreading glue, assembly of the long individual laminations after spreading, and for clamping the assembly before curing the glue. Often, individual laminates 50 to

Various Types of Wood Adhesives Used Today

Type	*Typical uses*	*Some present limitations*[1]
Animal glues	Edge gluing and assembly of furniture.	Low moisture resistance, limited application conditions.
Starch glues	Still used for some veneering of furniture panels.	Low moisture resistance; slow setting.
Casein glues	Laminating timbers for interior use.	Low resistance to moisture and microbiological attack.
Soybean glues and blood glues and blends.	Some interior-type softwood plywood.	Same as casein.
Urea resins	Interior hardwood plywood, furniture plywood, particle board binders (interior use).	Limited heat resistance. Not durable outdoors.
Phenol resins	Exterior-type softwood plywood. Binder for more durable particle board.	Has dark color; needs hot presses; slow curing at lower temperatures.
Resorcinol and phenol-resorcinol resins	Laminating timbers for exterior use.	Dark color; slow curing, particularly at low shop temperatures; expensive.
Melamine resins	Only as a fortifying agent to improve durability of urea resin glues for hardwood plywood and edge- and end-glued lumber.	Slow setting; expensive.
Polyvinyl acetate	Assembly of furniture, flush doors, plastic laminate bonding to wood.	Low moisture and heat resistance; non-durable outdoors; possible creep.
Rubber-base contact adhesives	Bonding plastic laminates and metals to wood.	Low initial strength. Durability requirements not yet established.

Notes: [1]In addition, all types can stand improvements in adaptability to new gluing operations, simpler control of bonding conditions in the plant, and lower cost—although each of these factors is somewhat relative and it is difficult to indicate actual levels of acceptance in this table.

100 feet long, one or two inches thick, and up to a foot or more in width must be surfaced, run through double-roll glue spreaders, and laid up into an assembly piece by piece. Then they are put under gluing pressure of 125 to 150 pounds per square inch, using large numbers of bolt-type individual clamps with rocker heads that tighten with electric or pneumatic wrenches.

Since few curved laminated timbers are made to the same size or curvature, clamps must be adaptable to a variety of contours. This is done by moving them and reseating them to the floor of the shop as required. In addition to the labor required, this process requires glues with rather long pot lives that tolerate an hour or more of assembly time, often partly open to the air, and yet will cure fairly rapidly once under pressure.

Since wood transmits heat very slowly when heated from the outside, it is not very practical to heat the clamped assembly from the outside in order to raise glue line temperatures to increase the rate of cure. Hence, glues that cure adequately without additional heat are desired. To avoid the long tieup of clamping equipment with present curing cycles of four hours or more, glues that permit faster cure cycles at normal shop temperatures would be very advantageous.

High-frequency heating of glue lines is one approach to faster cure cycles. Its applicability at present, however, is limited by the high cost of generators of the required capacity and by problems in electrode design compatible with the clamping equipment currently used.

Other problems in the laminating industry include development of adhesives that are compatible with fire-retardant and preservative-treating chemicals, which are often incorporated in the wood before gluing, and of faster setting durable glues, preferably colorless, for the end joints in the long laminations. These end joints are now generally made with long tapered scarfs, but a variety of finger-type joints are being considered.

Expansion Expected

One phase of the laminated wood industry that is very likely to expand considerably in the next few years is the production of smaller, flat laminated pieces for stock uses. This material will compete with, and ultimately replace, the larger solid timbers that are becoming more and more scarce in the species and grades required.

Such laminating operations are quite likely to be a part of a sawmill operation, as a means of better utilization of smaller wood pieces. As such, the gluing process could be entirely different from the custom laminating just described. Stock laminates probably should be produced on semiautomatic production lines for economy.

A current development is the laminating of two- by four-inch studs from surplus one-inch lumber. One interesting technique tried utilizes the principle of heating the wood surfaces first, and then rapidly spreading a liquid phenol-resin glue, or inserting a dry phenolic film glue. This is followed by rapid application of gluing pressure to allow fast curing in automatic presses (*6*). For such stock items to be used interchangeably with solid wood, all-service durability is required, since it will be impractical to handle and retain the separate identity of interior and exterior quality laminated products of this type.

Another gluing operation that is likely to be closely associated with sawmilling is the gluing of smaller,

odd-sized pieces of one-inch lumber to standard panel sizes. Such utilization, which will permit the marketing of high-quality lumber in large standard-sized pieces, involves both edge-gluing and end-gluing of lumber (*7*). The finger-jointing operation, to first produce long lengths out of short pieces, requires an entirely new gluing approach. The operation should be essentially continuous, such as on a conveyor with different feed and off-feed rolls for end pressure, so that joints can be rapidly machined and glued. Then automatic saws can cut the glued pieces to any desired standard lengths.

Need Continuous Operation

For the subsequent edge-gluing process, a continuous bonding operation must also be developed. As with many glued wood products, a single type of glue line would be preferable for all such glued lumber products, so that they may be used with confidence anywhere that solid lumber has been found to be suitable.

A half and half urea-melamine resin combination has so far proved most satisfactory for making edge- and end-glued lumber from the production standpoint as well as for its appearance and durability. This adhesive requires an elevated curing temperature, achieved either with heated platens or with high-frequency heating. Its long term permanence for structural uses under the more severe service conditions, however, has not yet been adequately established.

Polyvinyl-acetate emulsion adhesives have been used at normal shop temperatures for some end-gluing of interior, nonstructural softwood lumber, such as millwork trim. These glues, however, are not moisture resistant and durable for the desired all-purpose glue joints.

In line with the current trend to produce structural components for the building industry, much interest has been shown recently in the manufacture of glued beams, trusses, and other structural components. The Douglas Fir Plywood Association has now established a subsidiary, Plywood Fabricators Service Inc., to assist in design and to supervise quality control of the fabrication of components of plywood and lumber. These components depend on strong, durable glue joints to distribute stresses from one piece to another and thus act as a single structural unit (*8*).

Structural components made in this way are said to provide greater efficiency in the utilization of material, to reduce cost, weight, and volume, and to improve performance through more rigid joints, permitting development of the full strength of the materials. Typical examples are plywood-web box beams, roof trusses with plywood gussets glued directly to framing members, and a variety of beautiful flat and curved roof panels.

Most of these glued component parts will be produced in relatively small shops or plants near the ultimate market. They will also be made in a variety of sizes and shapes so that conventional spreading and pressing operations are not likely to be practical. Ultimately, some on-the-site gluing may be desired. These limitations put special emphasis on contact-type adhesives that can be spread only on the lumber frame surface and will set without presses or require the nail pressure now required with the current casein and resorcinol-type adhesives. Heat curing is not likely to be feasible in such operations.

Improving Veneer Performance

The use of paper and paper-plastic overlays to improve the performance of veneer, plywood, and lumber is receiving consideration by glued products manufacturers. Douglas fir plywood overlaid with high-density paper plastics has proved its utility as a concrete form material, resulting not only in a smooth surface on the concrete pour, but also in greatly extended service life of the form materials themselves.

Masking of surface defects and greatly improved paintability of Douglas fir plywood are other advantages of overlays. These overlays are bonded with durable phenol-resin glues. Paper-overlaid veneer is now produced by several plants primarily for the packaging field. Adhesives in this case include low-cost urea resins and soybean types, sometimes applied in a conventional hot-pressing operation, or, in at least one installation, in a continuous roller-pressing operation.

The advantages of overlaid lumber of southern yellow pine have been demonstrated on a laboratory scale for such uses as siding with better paint-holding properties or stadium seats without splinters, but the commercial exploitation of these products remains for the future (*9*). Most desirable for production of paper-overlaid lumber would be a continuous bonding operation somewhat like that used in the manufacture of some paper-overlaid veneer but with an all-purpose durable glue line.

Upgrading Lumber

Overlaying of lumber offers the possibility of greatly upgrading relatively low grades of lumber by masking defects, such as knots and mineral streaks. It also masks the coarse grain pattern of some softwoods that are not normally acceptable for painting and makes the product acceptable as high-quality trim lumber. The lumber to be overlaid can first be edge and end glued into panels. The overlays will then cover the glue lines and mask the differences in color and grain of individual pieces as well as the defects themselves.

For lumber panel sheathing, untreated kraft paper overlays are glued on each surface with a less durable glue, often without edge-gluing the pieces, to provide a standard-size sheet for easy handling and erection, as with plywood and other sheet materials. Once the panels are properly nailed in place, the glue lines are of only secondary importance.

Another product with market potential already receiving attention is wood overlaid with durable plastic films, either transparent or opaque and pigmented. Such overlaid material is one answer to factory-finished lumber or plywood, and permits wood to compete more effectively with similarly finished metal products. Special adhesives will be required here, with good resistance to heat and ultraviolet

About the Author . . .

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rays, and with good optical clarity and stability when used with the transparent films.

Sandwich panels of thin but strong facings and low-density cores have been used in engineering construction where lightweight panels of high strength are required, such as in military aircraft. A major potential use of such panels is in housing, both for structural and nonstructural partitions. The glue lines must be adequate not only to meet rigid strength requirements, but to serve well under conditions of varying humidity and temperature.

Wide varieties of wood products may be used in the construction of sandwich panels. For facings, such panel materials as plywood, hardboard, fiberboard, and resin-treated paper or plastic laminates may be used, whereas the cores may be of wood, insulating fiberboard, or paper honeycomb materials.

In 1947, the U.S. Forest Products Laboratory erected a small demonstration building in which the floor, wall, and roof panels were of structural sandwich (*10*). The core was phenolic-resin-treated paper honeycomb bonded with a phenol-resin adhesive to a variety of skins, including plywood, hardboard, and cement asbestos board. These panels are still performing satisfactorily and test exposures will be continued indefinitely.

In some sandwich building panels, metal or plastic foils may be incorporated as vapor barriers, and surfacing materials, such as paper plastics or other synthetic film materials, could possibly be bonded to the outer surfaces to improve or replace painting. As with other factory-made component products of large and variable size, a continuous bonding process with contact adhesives would be desirable for bonding faces and cores of such panels. Unfortunately, adhesives of this type with the necessary performance for such applications are not yet available.

Another requirement for an improved adhesive-bonding system is a suitable means of field jointing of the component sandwich panels on the construction site. In addition to having suitable application properties under a wide variety of climatic conditions, the glue lines must also be durable. As with many other bonding applications, the design of the bonded joint here is at least as important as the adhesive itself.

Particle board is a relatively new wood product that originated in Europe after World War II and was introduced into the United States in the last ten years. It is produced in flat sheets by the bonding of a variety of wood particles, from planer shavings to specially-made flakes cut from short lengths of waste lumber or round wood. It was first used as core stock for veneered furniture panels to replace edge-glued lumber cores. Other uses are being developed.

It is estimated that 375 million square feet of particle board on a ½-inch basis were produced in 1958, mostly with urea-resin binders. Assuming that this was in the form of panels ½ inch thick, with a density of 40 pounds per cubic foot, and with a resin content of six per cent, this use required approximately 25 million pounds of binder on the dry basis. In addition to the present utilization of wood waste, the particle board process is of particular interest because it may offer a possibility of utilizing some of the 4.8 billion cubic feet of forest and mill residues mentioned earlier. Uses for particle board are continually being developed and promoted (*11*).

Important problems confronting the particle board industry are the development of panels that will be suitable for exterior service, such as wall panels, soffit boards, and porch or carport ceilings, and of processes for making shaped or molded products, such as sash and trim, for the building industry. The binder resins for particle board must be very efficient at low levels.

At present, six to eight per cent of urea-resin or three to six per cent of phenol-resin binders are used, based on the weight of dry wood. This results in only spot bonding as compared to the continuous glue lines typical of conventional wood gluing. Hot presses are normally used at platen temperatures of 300°F. or higher, but some boards are made in special extruders. Modern plants are rather well engineered and automated as compared to most present plywood plants.

Adding Resin Binder

Approximately half of the two billion square feet of hardboard produced annually on a ⅛-inch basis requires the addition of a small percentage of resin binder to supplement the natural hardboard bond. The wood is typically a coarse fiber made by a high yield mechanical pulping process. The added resin, nearly always a phenolic at present, is in liquid form and with suitable pH control, it is precipitated on the fibers by the addition of alum. The felted mat is then hot pressed.

The previous discussion has indicated some of the developments in the glued products field and the need for new glues and gluing processes to make possible further development. Although no significantly new and different wood adhesives have appeared in recent years, important developments have nevertheless taken place in the bonding of metals, paper, and plastics that may perhaps have some application in the gluing of wood. Research and development is underway in the chemical industry to develop new basic polymers for use in many applications, including new synthetic textile fibers, molded plastics, laminating resins, and paints and finishes. Some of these developments may lead to important progress in wood bonding.

At the Symposium on Adhesives for the Wood Industry, held at the U.S. Forest Products Laboratory in Madison on January 13-15, 1960,

some of these expanded markets for glues in new wood products not currently in production, or even under development, were considered (*12*). Present at this meeting were executives and research people who represented the wood industry, the manufacturers of wood adhesives and other types of adhesives, and representatives from the basic chemical industry.

The need for greater cooperation between adhesive manufacturers, adhesive users, and manufacturers of gluing equipment was brought out at the meeting. For any newly proposed application, the first need is a clear definition of the exact requirements for an adhesive. This includes a realistic examination of use requirements, with emphasis on those properties that are of utmost importance and, perhaps, with some compromise regarding the less critical requirements.

Although cost is recognized as a paramount factor in the final glued product, it was pointed out that a more expensive adhesive, on a "per pound" basis, might bring about great economies in production through reduced labor requirements or in the reduction of rejects. The cost of the adhesive itself, therefore, might be of relatively little importance. Likewise, the cost differential between the glued product and the solid wood product that it will replace will decrease in the future as our supply of solid wood in the desired species, grades, and sizes decreases and its price continues to rise.

Because the wood product manufacturer understands, better than anyone else, the requirements of the product that he intends to make, he is in a key position with regard to the development or adaptation of a new glue or gluing process. He must therefore be prepared to share the development cost with the adhesive manufacturer who may spend large sums of money on research without the prospect of realizing any profit. The potential glue user should also do more of the evaluation of new adhesives and bonding processes and take a greater initiative in establishing the necessary evaluation procedures and performance requirements.

The manufacturer of new gluing equipment must be brought into the picture at an earlier stage than is customary at present. As was pointed out earlier in discussing a number of glued products, the development of new gluing equipment is essential to the success of many new gluing operations. This concerns not only equipment for the actual gluing operation, but also for the mechanization and automation of the cutting and other machining operations, including the materials handling problems. The materials handling problem is particularly critical in end and edge gluing many small pieces.

Accelerating Cure

The development of a really fast-setting adhesive, which many of us clamor for, boils down to the problem of accelerating the chemical reaction in the curing of polymeric materials. These chemical reactions are characteristic of a broad field of chemical technology, and the solution to the problem of accelerated curing may likely come from some area other than the present adhesive industry.

One recent possibility for faster cure is the encapsulation of reactive hardeners or catalysts added to resin adhesives, which are then spread (*13*). The application of gluing pressure then crushes the microcapsules and permits the accelerated reaction at the desired time. This assumes the ability to crush such capsules completely between the two wood surfaces, which are often rather nonuniform and with glue lines of somewhat variable thickness. Perhaps a controlled degree of solubility of the encapsulating material in the adhesive base would work better here.

It is also quite possible that some of the basic chemical knowledge of catalysis of organic chemical reactions, developed for reactions far beyond the present adhesives field, might suggest new means to accelerate the cure of new wood adhesives to meet some of the requirements previously cited.

It is therefore hoped that a greater degree of understanding of the potentials of adhesives in the expanding wood industry and the large markets for chemicals in this area will stimulate chemical and adhesive manufacturers to re-examine older materials and products for these uses and to consider these uses in screening new products under development for other applications.

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Minute Quantities of Epoxy Bond Miniaturized Microphones

High adhesion, low viscosity, good stability and completely predictable behavior make the use of epoxy a "must" in various assembly operations

A degree of miniaturization heretofore considered impossible in the manufacture of microphones used in hearing aids has been obtained by using epoxy resin formulations to assemble tiny components. The amounts of epoxy involved are as little as .002 inch in thickness and the design approach has resulted in what is probably the world's smallest unit.

Executives at Dyna Magnetic Devices, Inc., Hicksville, N.Y., explain that the chief characteristics of epoxy compounds that led to their selection for use in miniaturized assembly are high adhesion, low viscosity, stability and completely predictable behavior. Dyna Magnetic relies on epoxies for virtually all aspects of the assembly operation. These include adhering magnets, bonding aluminum and plastic pieces that form the laminated diaphragm and mounting a coil on a metal piece with clearance inside the coil.

Eliminates Part

Use of epoxy in the coil-mounting operation has not only made possible careful positioning of the coil without damage but has also contributed to elimination of a space consuming part. Prior to the use of epoxy here it was necessary to use a coil bobbin. Elimination of this part, of course, was a factor in miniaturization.

Predictable behavior was essential in any material selected for bonding these highly miniaturized components because the slightest instability on the part of the bonding agent, or the slightest physical damage to the components during the bonding operation, could harm the electrical characteristics of the finished assembly. Here are some examples of why this factor of predictable behavior is so important at Dyna Magnetic.

Because of the degree of miniaturization achieved by this manufacturer, the adhesive material, which is supplied by Smooth-On Mfg. Co., Jersey City, N. J., must occupy a tiny, specific area, and occupy it neatly. There can be no overlap into areas where it does not belong. There can be no excess material, no scraping, no removal of surplus.

At the same time, the build-up of any adhesive material used must be within a specific range of thickness in view of the tight dimensional specifications. In most bonding applications in the Dyna Magnetic microphone the adhesive material cannot build up to a thickness greater than .007 inch, nor remain below .004 inch. Epoxies stay within this narrow .003 inch thickness margin.

Stability of the bonding material is another essential. Take, for example, one component in the microphone assembly, a vibrating member so sensitive that its travel is measured in millionths of an inch. The slightest physical change in the bonding material after its application could have serious impact on this tiny part.

Every drop of bonding material that goes into the microphone assembly must be carefully weighed and accounted for in terms of overall specifications. The weight of each drop at time of application must be virtually a "final" figure. Any significant change in weight as a result of instability of the material means that the finished assembly will not meet specifications.

Curing Schedules

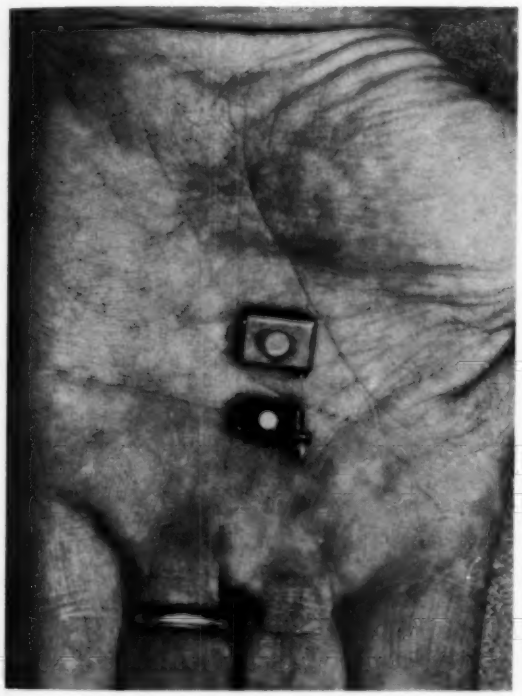
The average heat cure for epoxy-bonded microphone components is an hour and a half at 180°F. However, the curing schedule will vary widely depending upon the specific assembly.

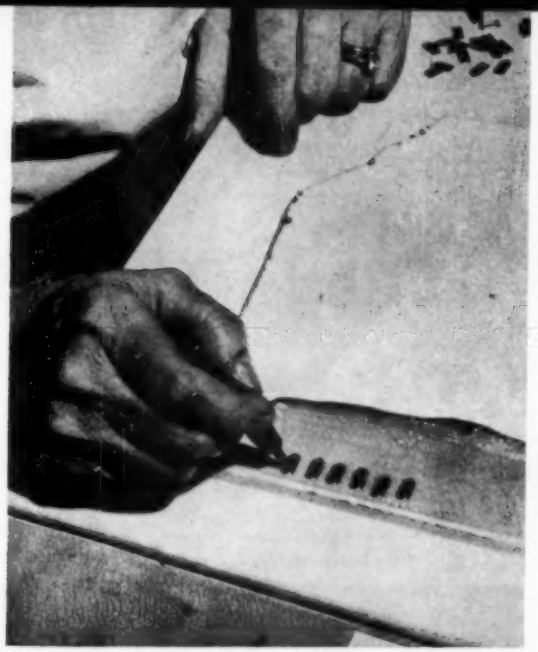
Welding and rubber cement, traditional joining methods, are still used in some instances by Dyna Magnetic. For example, where specific and undisturbed contact between two parts is desirable, as in the case of bonding the front end of the microphone to the outside container, welding is still employed. In one instance where physical removal of a partially-completed assembly for a heat cure is risky, a rubber adhesive compound is used in preference to epoxies.

But where no physical strain, no disturbance, no metal deformation, no changes in weight or temperature can be tolerated lest electrical characteristics be impaired, then epoxy resin compounds are preferred. The predictable behavior of these compounds permits strict adherence to design specifications regardless of how critical the operation.

The photograph immediately below demonstrates how epoxies have been able to bring about improved miniaturization. The top speaker was the smallest unit possible with previous bonding methods. Below it is the current design which has been achieved through the use of minute quantities of epoxy adhesive formulations.

Pre-weighed epoxy compound formulated for miniaturized bonding applications by Smooth-On Mfg. Co. is mixed by employee at Dyna Magnetic Devices. The electric mixer in the background is used to assure that the formulation components are completely blended.





In some bonding applications for the microphone, the epoxy is rolled as thin as .002 inch. At the top of the page, the operator has rolled out the epoxy and is now placing on it aluminum components that will be adhered to a strip of tape. Though the amount of epoxy involved is minute, the bond will withstand considerable strain.

Coil mounting is one of the assembly operations in the manufacture of miniaturized hearing-aid microphones. Minute quantities of epoxy bond the coil to the armature. The switch to epoxies eliminated the need for a coil bobbin so that the unit's size could be further decreased.

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Resin-Bonded Particle Board Turns Wood Waste to Profit

In recent years, rising lumber costs and the desire to produce a product free of the natural defects of lumber have spurred significant progress in particle board manufacturing techniques. In addition, the development of resin adhesives has removed many practical difficulties that limited progress in this field.

Particle board manufacture makes possible the utilization of wood waste from various sources. Different production methods have been developed by various firms. Some systems used for making particle board from re-aggregated waste incorporate a platen-type press with multiple openings. Other techniques call for the use of an extrusion press.

It is seldom feasible for those who install particle board processing plants to maintain a completely fixed design for the purpose; it might not prove adaptable to various conditions found in the field. Factors that must be taken into consideration include sources and characteristics of waste material employed; the end use for the product, and available space for plant installation. Therefore, equipment suited to basic requirements is usually worked out individually. Current installations range all the way from small batch-type plants to huge layouts incorporating a continuous type of operation.

A considerable amount of engineering know-how is required to develop a plant which under specifically limited circumstances will produce good particle board at the lowest possible cost from a given type of wood waste. Perhaps a primary necessity is the preparation of reasonably-uniform chips or particles.

Though differences exist in methods of producing chips, flakes, and the like, the basic and chiefly employed technique is by hammermill. Sometimes referred to as a shredder, or even a refuse hog, such a unit generally incorporates revolving hammers whose sharp chisel-like edges reduce wood chiefly by impact and to a lesser small degree by actual cutting. In this reduction method, no delicate sharp knives are required, and the particles produced are of the splinter type, generally having considerable length in relationship to their cross-sectional dimensions.

For Greater Strength

This long, slender particle form is important as it lends greater strength to manufactured board, just as long-fiber papers are superior in strength to short-fiber stock. For relatively small production, a so-called one-stage plant is usually employed, while for larger throughput, a two-stage plant is often favored. The basic difference between these two setups is that a single-stage plant uses only one reduction unit whereas a two-stage plant uses two.

After initial reduction of wood waste by the hammermill, resulting particles are elevated, generally by a blower system, to a cyclone collector, which deposits them on a double-deck screen. The top screen is of a mesh which will not pass particles too coarse to process into particle board. The secondary screen, just below, incorporates openings which will not retain particles that are too fine.

Particles which will not pass through the initial screen are returned to the hog in the one-stage plant. In a two-stage layout, they pass to the second hog, sometimes called a reshredder, which is specifically designed for handling and reducing this smaller-than-original material. After this second reduction, the material is again elevated, and returned to the same double-deck screen.

Particles which pass through the first screen and are retained by the second, are classed acceptable and are automatically routed to a storage bin. Such fines as pass through both screens are transferred by air to a fuel bunker, or other point of disposal.

Sometimes, material being reduced is dry, representing lumber and veneer waste coming from furniture-manufacturing or planing-mill operations, and the like. Other times, however, much green waste from sawmills is processed and built-in drying equipment is required in the layout to insure that particles are sufficiently dry before they pass into the storage bin. The capacity of this initial stage of operations is pre-calculated, so that there will always be enough particles in the surge bin to supply the balance of the plant, for whatever amount of output may have been preliminarily used as a production target.

Sometimes, forms of wood waste available may make it expedient to use—at least in part—material which cannot logically be reduced to splinter-type particles. In some cases, a differentiation is made as between the center portion of board volume and faces of particle board; the required operation is then somewhat more complex. Sometimes, too, specialty board is produced which

for the sake of appearance incorporates flakes on its surfaces. Some firms have developed their own methods for producing specific types of flakes or other particles for facing purposes. Though some phenol-formaldehyde resin is used, a combination of utilitarian and cost considerations has caused urea resins to be used in the majority of particle board produced.

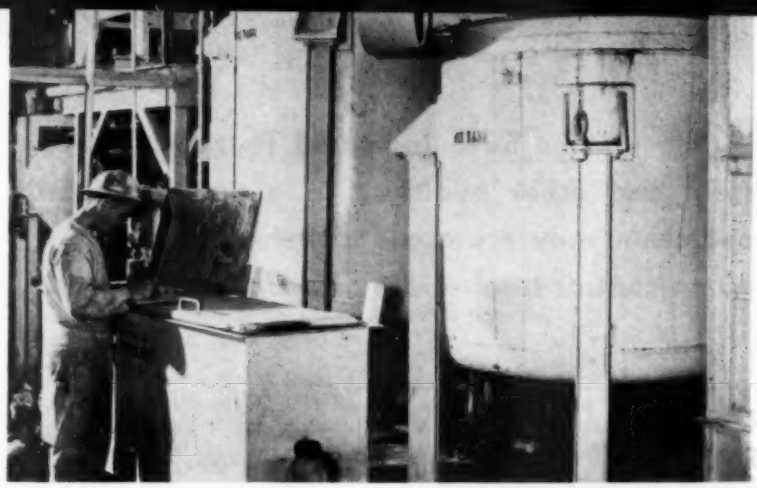
Sometimes, as a matter of using its own waste material profitably, a large furniture plant may develop a relatively simple batch-type operation in which wood particles are removed from the storage bin through a hopper which accurately measures the correct amount for a batch. (Small plants sometimes use a simple hot plate press having no more than one or two openings. This press may be employed for panel production when it is not pressing particle board.)

Fed to Mixer

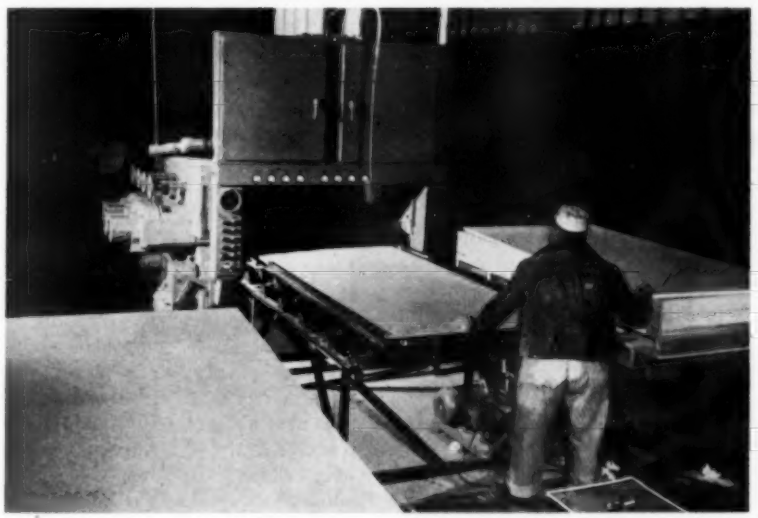
The particles are then passed from the hopper into a mixer or blender, into which resin is introduced in proper relative quantity, usually in conjunction with some type of catalyst combination. The ratio of resin to wood particles is carefully predetermined, so a suitable quality of board will be produced. After spreading the particles-and-resin mix on cauls or trays, a pre-pressing operation often takes place. The prepared "mats" then proceed to final pressing.

Glue mixing and storage equipment used in conjunction with particle board manufacture obviously must dovetail with and have a volume capacity suitable to the balance of the operation. On large operations, remarkably-large glue mixers and storage tanks are found; no small part of over-all responsibility is vested in having a suitable amount of properly prepared resin available at all times.

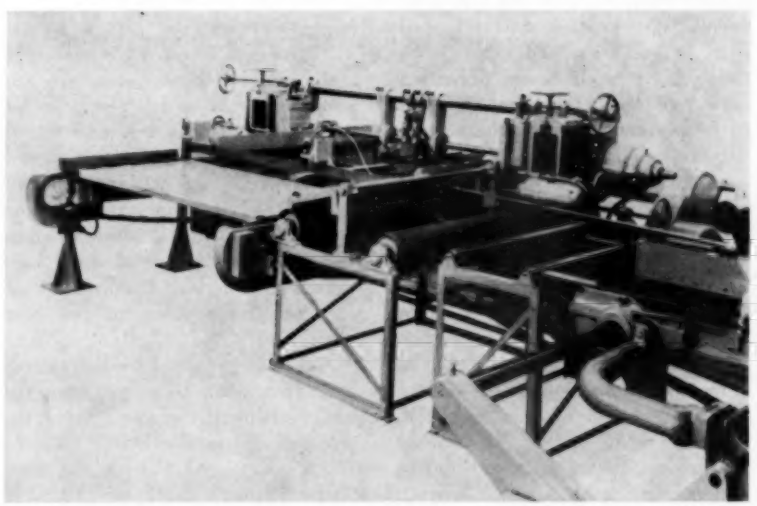
In larger plants, screw conveyors operating at controlled rates feed particles from the bottom of the storage bin onto a belt conveyor which carries them to a continuous tumble type mixer. Here, the particles, resins, and any other additives are properly blended. However, the chips pass over some type of continuous weighing mechanism, enroute



A 400-gallon mixer installed in tandem with a 600-gallon resin storage tank at Weyerhaeuser Timber Co. (Photo courtesy of Black Bros. Co., Inc., Mendota, Ill.)



Final machine of double-end units for sizing particle board to width and trimming it to length at Weyerhaeuser. (Photo courtesy of Greeniee Bros. & Co., Rockford, Ill.)



An eight-drum double-deck sander at Brownesville Particle Board and Associated Products, Brownesville, Ore. (Photo courtesy of Solem Machine Co., Rockford, Ill.)

"Some studies have indicated that the cost of resin and other additives in a particle board operation may represent anywhere from 40 to 60 percent of total direct manufacturing costs."

Typical of these units is the Weightometer made by Merrick Scale Manufacturing Co. It is designed to weigh moving loads continuously by mechanically multiplying two variable quantities together, and totalizing the successive products. These variable quantities consist of (1) whatever variation is present in the actual load on the conveyor belt, and (2) any slight variations which may occur in the feed of the conveyor belt. Remarkable accuracy in weighing wood particles or other material as they pass over a conveyor belt is obtained with such a device.

Another excellent weighing device for this operation is made by Jeffrey Mfg. Co. It incorporates a weighing belt, the actual operation of which is not one of static balance, but a condition of slow continuous swing from slightly overweight to slightly underweight.

Automated Production

Of great interest, are the automated methods which have been developed for precisely proportioning the resin to the volume of wood particles coming over the belt conveyor. Some studies have indicated that cost of resin and other additives in a particle board operation may represent anywhere from 40 to 60 per cent of total direct manufacturing cost, and that the average plant may have manufacturing costs in the neighborhood of 3/4 million dollars per year. There are variations, depending on the nature of wood particles used, and efficiency with which resin and other additives are measured.

In addition to the binding resin, some operations provide for adding a small amount of wax emulsion, the function of which is to decrease the amount of water absorption to which particle board is subject. However, there is difference of opinion as to whether addition of wax is particularly desirable, when all the factors are considered.

Studies have also been made as to the desirability of adding pentachlorophenate to the resin before it is applied to chips. The purpose here is to protect the material against termites, just as such chemicals are used in other forms of wood preservation. The addition of such chemicals is desirable only where the end product will be used in contact with the earth or weather. It is of no value in particle board for use in furniture construction and the like.

In one case observed, high accuracy was developed on an automatic basis in proportioning and adding resin to wood particles at the mixing drum or blender, by means of an automatically controlled, reciprocating, proportioning pump. The resin delivery rate of this pump was governed by automatic signals from totalizer-equipped conveyor scales over which wood particles were routed to the blenders. In this particular plant, the resin solution pumped to the mixer may either be urea-formaldehyde in a 60 per cent solution, or phenol-formaldehyde in a 30 per cent solution, by weight.

The system employed is such that resin solids-to-wood ratios are adjustable up to seven per cent by weight for urea resins, and up to six per cent by weight for phenol resins. The system will maintain an accuracy of less than plus or minus one per cent of the maximum pumping rate, based on total wood particle weight derived from a totalizer incorporated within the conveyor scales.

Controls provided by the system include a resin-to-wood-percentage ratio setting; government over the proportion of resin solids to resin liquid, plus either manual or automatic operation of the discharge rate of the resin pump. A valuable feature is a correction setting provided for the percentage of wood-moisture content. In addition the system provides specific recording functions, and means for automatically sounding an alarm, should any proportioning malfunction occur.

The proportioning pump employed is of sufficient capacity to pump the required amount of resin. It is driven by a dc motor, having a Thyratron tube power supply governed by the control system. A definite advantage is gained by using the fundamental approach often employed in additive proportioning; pump-stroke length is held constant, so displacement is positive for each stroke. Any desired variation in pump delivery is obtained by varying the pump rpm.

Varying the pump rpm, as may be necessary to adjust the volume of resin delivered to the blenders, allows a tachometer-generator to be driven by the pump. With pump displacement thus varying in direct ratio with rpm, setting means is provided to accommodate desired rates of delivery. Moreover, the tachometer-generator driven by the pump can have its voltage automatically recorded on a chart. This gives a permanent record of additive rate, in terms of both quantity and percentage.

Pump-Stroke Counter

A stroke counter is used on the pump, the crank of which actuates a proximity limit switch to pulse a pump-stroke counter or integrator. This is done by attaching a small transformer-iron vane to the pump crank. The vane travels through the slot of the proximity limit switch, thus actuating the counter. By counting the pump strokes in this fashion, and using a calibration factor, the gallons pumped are totalized.

In the particular layout being discussed, the automatic weighing scales for wood particles were located about 60 feet away from the mixing drum; about 30 seconds of transportation time was required for particles to travel from the weighing scales to the drum. Because of this 30-second interval, it was necessary to find means to provide a 30-second time delay between

actual weighing of wood particles and injection of resin through spray nozzles into the drum.

If such a delay between the weighing-belt signal and actual spraying of adhesive were not provided, resin would be pumped into an empty mixer before wood particles arrived. In addition, pumping action into a full drum would stop before the wood particles were discharged.

To provide the necessary time delay, a device was worked out which integrates the wood-weight signal in two-second increments, and delivers these increments to the pumping system 30 seconds later. In this way, wood particles and resin enter the mixer in proper sequence.

The time-delay device, which is an integral part of the controls, is a special commutator, driven by a synchronous motor at two rpm. Each segment of the commutator is connected to a capacitor charged by the incoming weight signal brush. As this commutator rotates, the capacitor charge is picked off by another brush 30 seconds later and is used as the control signal. A divider servomechanism is employed to divide the actual pumping-rate signal (derived from the pump-driven tachometer-generator) by the wood weight signal.

An air signal from the automatic traveling-belt scale is recorded as the wood weight. A weight-to-electric transducer is employed to give the pumping control signal. This transducer uses a precision potentiometer, mounted on the scale-integrating mechanism. It varies the voltage from a regulated power supply, thus providing the control signal. The combined weight signals are fed to the time-delay commutator, and from there to a so-called wood amplifier.

A relay amplifier, which is fed from the wood-amplifier output, detects any absence of a wood signal. If necessary, it performs necessary switching functions to stop the pump by feeding a negative voltage to the control amplifiers. Whenever the wood signal exceeds the specified minimum, however, the output of the wood amplifier is fed to the resin amplifier through the automatic rate-adjusting potentiometer. The resin amplifier, in turn, feeds the dc power supply, which serves the resin-pump motor.

The tachometer-generator attached to the pump motor shaft not only provides the signal for the resin recorder, but also supplies a feedback signal for the resin amplifier. This resin amplifier is so designed that its output adjusts until the feedback signal precisely equals the input signal. Consequently, the feedback voltage is a measure of the pumping rate. It is compared with the wood signal appearing across a motor-driven potentiometer. Any difference between the wood signal and the pump signal is amplified, to drive the servomotor until voltage from the motor-driven potentiometer is precisely equal to pumping-rate voltage.

Types of Presses

Many variables may be found in setups for particle board manufacture. A chief difference found in plant layout is the type of press employed. One system involves receiving resin-mixed wood particles from the blender onto cauls or into trays, and pre-pressing each tray load into a mat. This permits its easy loading into a multiple-opening hot plate press, quite similar to those used in hot-plate pressing plywood. Another system employed forces the mixture through an extrusion press.

To provide particle board with clean edges, in proper width and length dimensions, double-end machines like those made by Greenlee Bros. and Co., Rockford, Ill., are generally employed. These size the particle board panels to net width, and trim them precisely to desired net length.

In practically all large volume plants, these units are set up in tandem, and at right angles so that as sized-to-width panels, trimmed on both edges simultaneously, pass through the first machine, they automatically come into position for feeding at a right angle through the second unit. The second machine trims both ends to net length, perfectly square with the edges already generated.

Final smoothing of particle board, combined with close-tolerance thickness dimensioning, may be accomplished either by planing or sanding. However, smoothing it through wide double-deck eight-drum sanders, such as those made by Solem Machine Co., Rockford, Ill., is the preferred method for various reasons. One of these is that most particle board panels are originally made four feet wide, like standard-width plywood. Rotary wood planers with a cutterhead of this length are difficult to build so as to insure there will be no whip or vibration in the revolving cutterhead shaft (which generally turns at 3600 rpm).

The sander drums, however, rotate at a much slower rate. Drum rotation, in fact, is often 1800 rpm, or exactly half that of a planer cutterhead shaft. Consequently, it is not at all difficult to build sanders with an effective working width of as much as 85 inches to process particle board of exceptional width.

About the Author . . .

JOHN E. HYLER is well known for his work on adhesives in various wood industry operations. His study of the subject began when only animal glues were available in this country. Mr. Hyler's articles have appeared in leading industry publications.

6 Tips on Selecting Adhesives for Small Carton Sealing

Choosing a good adhesive isn't enough—it has to be suitable for the specific production line on which it will be run

By EARL C. LENZ
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New York 19, N.Y.

The ability of a carton to provide protection against pilferers, vermin, impurities and sifting of free-flowing contents will depend upon the proper sealing of the carton flaps. As a result, the need for careful consideration in selecting carton sealing adhesives cannot be overemphasized.

Adhesives become an integral part of the carton construction and thus may be used to enhance the structural characteristics of the entire package. They should not only provide the precise type of seal required, but also be formulated to function properly in modern high-speed automatic carton sealing machines so that production schedules are maintained and labor costs minimized.

Most carton sealing adhesives are water-borne and usually based on colloidal materials such as dextrines, animal glues, and resin emulsions. They are blended or compounded with various chemical additives to adjust the adhesive to specific applications. The variables introduced by the many possible combinations of carton stock, sealing machine, speed, and package contents make a careful choice of carton sealing adhesives vital. The following six tips may help:

(1) Consider the type of carton stock, which will play a significant role in adhesive performance. In general, board types such as bending chip, news vat lined chip, single manila, and bleached manila can be bonded effectively by a relatively wide range of dextrine or resin adhesives. On the other hand, patent-coated, clay-coated, and solid bleached sulfate boards may present troublesome problems if the adhesive is not chosen specifically for the precise board used. Special boards, such as those coated with polyester, wax, etc., will invariably require a specialized adhesive to form effective seals.

About the Author . . .

EARL C. LENZ, vice president of sales and advertising at Morningstar-Paisley, Inc., joined the company's Chicago Division in 1932, in a technical sales capacity. A Lewis Institute graduate, he brings an engineering approach to adhesive problems.

Calling upon the technical service department of a reliable adhesives producer for help will prevent problems from cropping up at the machine—or poor seals from showing up at a later date.

(2) The type of machine to be used is another basic factor upon which the choice of adhesive will depend. Fully automatic cartoning machines, carton sealing machines, fully automatic top and bottom sealers, and vertical semi-automatic carton sealers operate differently and require different types of adhesive to insure a seal of good quality.

Production Speed

(3) The speed of the operation will influence the choice of adhesive, as will the adhesive application technique. The more complex the operation, the more need for adhesives with controlled penetration and chemical action. These qualities bring about a predetermined rate of evaporation or absorption by both board surfaces being bonded. Thus the adhesive film loses sufficient moisture to change from a fluid to a colloidal gel with sufficient tensile strength to hold the flaps together when pressure is removed.

(4) Compression time of the carton machine is another important consideration. Generally, most dryer units of carton machines are designed to hold the cartons under compression from 30 to 60 seconds. This lengthy compression time, based upon the use of dextrine adhesives, has made it necessary to

use a large amount of valuable floor space.

The advent of resin adhesives has changed the picture considerably by reducing the need for floor space by 50 per cent or more. Thus, use of the price differential between dextrine and resin adhesives as the basis for determining costs is not valid. Although the resin types are priced higher, they offer greater mileage and a significant increase in the efficiency of the operation.

(5) Consider the carton contents when selecting the adhesive. For example, food products prohibit the use of adhesives containing solvents or other odorous ingredients that would contaminate or impart a foreign taste or odor to the contents. Products such as soluble coffee, cocoa, tea, dehydrated soups, sugar, margarine, chocolate, candies, and tobacco, even when packed in an inner liner, will pick up and retain odors tenaciously. Soaps also have a tendency to absorb disagreeable odors.

Vegetable-based carton sealing adhesives have been used for many years in these types of applications because they will not affect the flavor, color or purity of the contents. In addition, many modern resin-based carton sealing gums are manufactured from solvent-free, specially purified resins and plasticizers. These will pass the test of the most discriminating user.

(6) The conditions to which the cartons will be subjected during production, handling, and storage will also influence adhesive choice. Will the packages have to withstand rough handling? Must they withstand atmospheric extremes in temperature and relative humidity?

Frozen Food Cartons

Especially important today are the seals of frozen food cartons, which must be engineered to withstand extremely low temperatures. Unusual conditions such as sterilization in autoclaves after sealing or extended water immersion are other factors on which the packager should base his choice of adhesive. Through extensive research, leading adhesives producers have developed formulas to meet the most rigorous conditions.

Computer Room's Floating Floor Bonded in Place

The need for instant access to wires and cables in computer and data processing rooms has been ingeniously solved by a system of "floating floors" raised above the subflooring on adhesive anchored pedestals. Used in conjunction with Remington Rand Univac and Burroughs Electrodata Systems, a pioneer installation of this space age floor was recently completed at the First National City Bank Building on Park Avenue in New York City.

A design of Floating Floors, Inc., New York, N.Y., the assembly is made up of a series of 18¼ x 18¼-inch die cast aluminum pedestals with steel footing. The latter are bonded to the sub-floor with a special adhesive designed for this application by Miracle Adhesive Corp., Bellmore, L.I., N.Y. The adhesive is simply trowelled on to the bottom of the steel footing.

The face of each aluminum plate is covered by an 18 x 18-inch vinyl tile surrounded by a metal or plastic lip the same height as the tile. The plates are instantly removable from their place in the floor assembly. A simple suction cup tool is used to grip and lift them so that inspection or repairs to the lines below may be made at any time without ripping up the entire computer room floor.

Some 650 gallons of adhesive were used in installing these floors in the computer rooms of the new bank building.

Partially installed raised floor. Man in foreground holds a pedestal which will be bonded to the room's sub-floor.

Adhesive is trowelled on to the bottom of a steel pedestal which will support the vinyl-covered aluminum plates.

Suction tool lifts aluminum plate to provide instant access to the complex of cables and leads for the computer.

The Influence of Some Selected Fabrication Variables on Structural Metal-to-Metal Bonding

By GEORGE EPSTEIN and SIDNEY LITVAK

Structural Materials Division
Aerojet-General Corp.
Azusa, California

Normetallic Materials Laboratory
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Wright-Patterson Air Force Base, Ohio

The use of adhesive bonding for joining similar and dissimilar metals in the fabrication of structural parts, has grown rapidly in number and type of applications. It is the purpose of this article to point up fabrication variables—surface condition of the adherends, air entrapment in liquid epoxy-base adhesives, use of primer coatings and their degree of cure, and the amount of pressure used during the assembly cure—which can influence the bonding properties of adhesive formulations. The resolution of these variables has aided the Aerojet-General Corp. in the development and manufacture of new concepts for military hardware.

The Structural Materials Division of Aerojet-General Corp. is one of the principal developers and users of specialized adhesive-bonded, load-bearing sandwich and laminate constructions. In particular, multiply metal laminated cylinders are being developed and produced in quantities for use as pressure vessels. The high performance of such composites depends upon the uniform stress distribution through the part; this, in turn, depends upon the quality and uniformity of the adhesive bond. Accordingly, an extensive investigation of variables which are considered to influence the strength of bonded joints was undertaken.

Two epoxy-base adhesives were employed in this study: Epibond 100 (manufactured by Furane Plastics Inc.) and AeroREZ E101 (Aerojet-General Corp.). In addition, Epon VIII (Shell Chemical Corp.), FM-47 tape (Bloomingdale Rubber Co.) and KB-1 epoxy-base adhesive (Aerojet-General Corp.) were also examined with heat-treated 4130 steel adherends (180,000 psi ultimate tensile strength).

Four fabrication parameters were investigated for application to adhesive-bonded multi-ply metal laminated structures. These were found to have significant effects on the properties of resulting bonded assemblies using epoxy-based adhesives.

Tensile-shear strength of metal-to-metal bonded structures was found to be significantly improved by:

(1) Surface treatment with Pre-Bond 700 for all metal adherends investigated, including steel alloys, titanium, beryllium, and nickel.

About the Authors . . .

GEORGE EPSTEIN is assistant chief engineer of Aerojet's Structural Materials Division. He is responsible for nonmetallic materials research and process development for missile, rockets, etc.

SIDNEY LITVAK is presently engaged in ASD research on high-temperature-resistant adhesives for bonding plastics and metals. Until 1960 he was with Aerojet's Structural Materials Div.

(2) The use of a vinyl-phenolic primer (FM-47) followed by complete cure.

(3) Evacuation of entrapped air from liquid epoxy-base adhesive system (AeroREZ E101).

(4) Curing under pressure of 15 psi for powdered epoxy-base adhesive system (Epibond 100).

Surface Treatments — Here the original objective was to establish a suitable surface treatment for high-strength, non-stainless steel alloy, in thin strip form, which would provide maximum joint strengths utilizing high-strength epoxy-base structural adhesives. The target was to obtain room temperature tensile-shear strengths which were in excess of 5000 psi using ¼-inch overlap lengths.

An extensive literature survey was undertaken to evaluate the best known metal surface preparations used for metal-to-metal bonding. These preparations were tested using Epibond 100, a powder epoxy-base adhesive with FM-47 primer, a vinyl-phenolic adhesive primer. The original test results were extremely disappointing (Table I). Using 0.010-inch thick, high-strength steel adherends, room temperature tensile-shear strengths of 2000-3500 psi were obtained, with bond failures largely adhesive in nature.

Surface Treatment Program

A program was then undertaken to obtain a surface treatment which would achieve the desired bond strength. This culminated in the development of a unique alkaline surface treatment (Pre-Bond 700, Bloomingdale Rubber Co.) which consistently produced tensile-shear strengths well in excess of the 5000 psi target value using ¼-inch overlap lengths (Table I).

Subsequently, it was desired to bond heat-treated 4130 steel with various adhesives. This same surface treatment was examined and found to give excellent results (Table II).

This surface treatment was also investigated with other metals — titanium, nickel, beryllium, and stainless steel. The results of these investigations are summarized below:

(1) Tensile-shear strengths exceeding 7500 psi (Table III) were obtained on titanium alloy B120-VCA (Crucible Steel Corp.) at room temperature. Other titanium alloys also gave comparable results. These values far surpass those which have been published in the literature.

(2) Excellent results were also observed with 17-7PH stainless steel, beryllium at 80,000 psi tensile strength (metal failures occurred in all tests), and nickel alloys (Table III).

Air Entrapment—While considerable test data for adhesive-bonded joints has been accumulated, meager information is available on the effect of air entrapment in the adhesive bond. A study of this variable was undertaken to evaluate its effect on the tensile-shear strength of AeroREZ E101, a liquid, epoxy-base, structural adhesive. (This adhesive is an Aerojet-formulated adhesive system with excellent lap-shear strengths up to 180°F.)

Structural Loads

The adhesive is employed to carry structural loads in excess of 20,000 pounds of force per inch width on a four-inch overlap, using ¼-inch thick, heat-treated 4130 steel alloy, with glue lines up to approximately 0.04-inch thick. Tests were conducted with FM-47 primed, 0.064-inch thick, clad 2024-T3 aluminum adherends, with both evacuated and non-evacuated adhesive, curing under contact and 15-psi pressures. Lap-shear specimens with 0.50-inch overlap length, were prepared and tested at room temperature. In both instances (contact and 15-psi pressure) when evacuation was not employed, varying percentages of voids (20-50 per cent) were observed in the glue lines, and failures were primarily adhesive in nature.

Statistical analysis of the test data shows that evacuation of the adhesive significantly improved the tensile-shear strength, yielding results about ten per cent higher than those of the non-evacuated system. Test results are given in Table IV. Typical specimens after test are shown in Figure 1. A discoloration of the non-evacuated adhesive was also apparent, probably due to the oxidizing effect of the entrapped air.

Primer Study — High quality

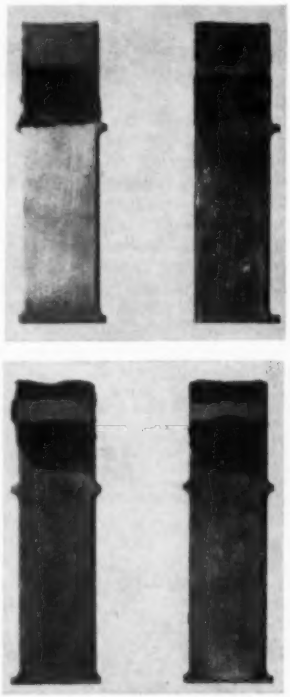


Figure 1a—Bonds made with contact pressure. In the top photo the adhesive has not been evacuated, in the bottom photo it has.

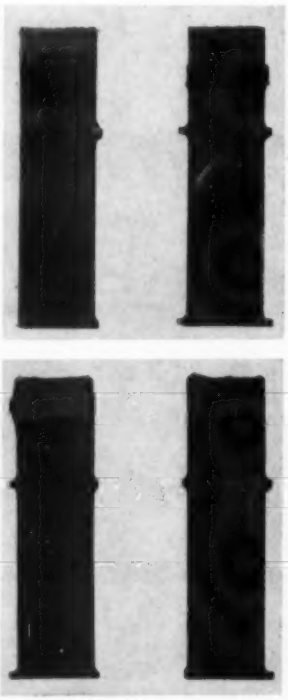


Figure 1b—Bonds made with 15 psi. Top photo, adhesive not evacuated; bottom photo, adhesive evacuated. All photos have been retouched.

Table I—Tensile-Shear Strength of Epibond 100 Adhesive on High-Strength Steel Utilizing Various Surface Treatments

Surface Treatment	*Tensile-Shear Strength (psi)*
Trichloroethylene vapor degrease	3400
Vapor degrease, sandblast, vapor degrease	3400
Scuff sand, vapor degrease	3400
Alkaline degrease	1600
Vapor degrease, alkaline degrease	1800
Solvent wipe with ketone	3200
Oxalic-sulfuric acid (Treatment G*)	3100
Dilute hydrofluoric acid (Treatment E*)	2200
Chromic-sulfuric acid (Treatment A*)	3000
Dilute sulfuric acid (Treatment K*)	3000
Dilute hydrochloric acid	3400
Pre-Bond 700 (Bloomingdale Rubber Co.)	8200

Notes: Specimens were ¼-inch overlap, using 0.010-inch thick steel strip adherends (a high-tensile-strength alloy similar in analysis to C-1065, with two per cent added nickel). Adherends were primed with FM-47 liquid adhesive and bonded with Epibond 100 adhesive. *Descriptions of these treatments are in WADC Technical Report 53-477, "Surface Treatment of Metals for Adhesive Bonding"

Table II—Tensile-Shear Strength for Various Adhesives on HT-4130 Steel Adherends

Adhesive	*Average Tensile-Shear Strength (psi) Unprimed*				*Primed*			
	−67°F.	*R.T.*	*175°F.*	*250°F.*	*−67°F.*	*R.T.*	*175°F.*	*250°F.*
Epon VIII/ Curing Agent "A"	2120	2840	3370	950	.....	.....	.....	.....
AeroREZ E101	4000	3840	2930	460	5070	5560	4410	920
FM-47 Tape	.....	.....	.....	.....	3940	3730	1350	540
Epibond 100	4160	4670	4010	830	5730	6770	5600	920
KB-1	4440	4300	4220	3300	.....	.....	.....	.....

Notes: All steel adherends were surface-prepared using Pre-Bond 700 cleaning compound. All lap-shear specimens were bonded using 0.50-inch overlaps. Testing was performed using a soak period of 3 minutes at elevated temperatures.

Table III—Tensile-Shear Strength of Epibond 100 Adhesive on Various Metal Adherends at Room Temperature

Adherend	*Average Tensile-Shear Strength (psi) Unprimed*	*Primed*
Titanium Alloy B120VCA, 0.010-in. thick		
Cold-rolled	7450	7540
Heat-aged	6540	7730
Stainless Steel, 17-7PH, 0.010-in. thick		
Condition C	------	6760
Heat-treated	------	6530
Beryllium, 0.010-in. thick	>3800 (metal failures)	.....
Pure Nickel, 0.050-in. thick	------	3500

Notes: FM-47 primer was used. All metal adherends were surface-prepared using Pre-Bond 700 cleaning compound.

Table IV—Effect of Evacuation on the Tensile-Shear Strength of AeroREZ E101

Cure Pressure (psi)	*Average Tensile-Shear (psi) Non-Evacuated*	*Evacuated*
Contact	4150	4510
15	4100	4610

Notes: AeroREZ E101 is a product of Aerojet-General Corp. Evacuation was for 30 minutes at room temperature, prior to preparing lap-shear specimens. All lap-shear specimens were bonded using 0.50-inch overlaps on FM-47 primed, 0.064-inch thick, clad 2024-T3 aluminum adherends. Tests were conducted at room temperature.

bonding requires a high degree of wetting of the metal surface by the adhesive. Thus it is essential that the faying surfaces be free of contamination, as well as receptive to the adhesive. Since production schedules may necessitate the processing of metal surfaces far in advance of actual bond fabrication, some kind of protection must be afforded the processed parts. Primer coating of the faying surfaces after processing, is an accepted procedure in metal-to-metal bonding. In general the primer may perform one or more of the following functions:

(1) Protection of the processed metal surfaces prior to bonding.

(2) Increase the peel and bend strengths of bonded assemblies.

(3) Increase the tensile-shear strength of bonded assemblies.

Results of Priming

Previous results (Table II) demonstrated that priming the metal adherends prior to bonding could increase the tensile-shear strength up to 50 per cent above that of the unprimed adhesive system. In particular, it was desired to achieve a narrower range of experimental test results. Primed adherends had been dried using a combination of air-dry at room temperature and oven-dry of ten minutes at 250° ±10°F. A study was initiated to ascertain the effect of a full primer cure (air-dry for one hour at room temperature, followed by one hour at 340° ± 10°F) on the tensile-shear strength of bonded specimens. All lap-shear specimens were bonded with Epibond 100 adhesive.

The test results indicate, using both 0.016-inch thick 7075-T6 aluminum and 0.008-inch thick high-strength steel adherends, that the fully cured primer lap-shear specimens give higher tensile-shear strength and much less scatter when compared to specimens where the primer was only dried (Table V).

In addition, lap-shear specimens were tested after storage for one week at room temperature in each of the following relative humidity environments: 0.0, 32.3, 45.0, 66.0, 90.0, and 100.0 per cent. Humidity chambers were prepared according

to Lange's Handbook of Chemistry, Third Edition, pages 1180-1181:

Relative Humidity	*Chamber Contents*
0.0%	Drierite
32.3%	$CaCl_2 \cdot 6H_2O$ (saturated solution)
45.0%	KNO_2 (saturated solution)
66.0%	$NaNO_2$ (saturated solution)
90.0%	$ZnSO_4 \cdot 7H_2O$ (saturated solution)
100.0%	Water

All tensile-shear tests were performed at room temperature in accordance with MIL-A-5090. Test results after humidity exposure (Table VI), again indicate less scatter and a higher average tensile-shear strength using the fully cured FM-47 primed steel adherends.

Pressure During Cure—A series of tests was conducted to evaluate the effect of bonding pressure on the tensile-shear strength of Epibond 100 adhesive at room temperature.

Lap-shear specimens were prepared using unprimed, 0.064-inch thick 2024-T3 clad aluminum adherends, bonded with Epibond 100 adhesive, with 0.50-inch overlaps. Specimens were cured for one hour at 350° ± 10°F. under the following pressures: 3.4, 7.5, 15, 40, and 100 psi. Test results are reported in Table VII and Figure 2, and indicate that the highest tensile-shear strength was obtained with 15-psi curing pressure.

Table VII—Evaluation of Cure Pressure for Epibond 100 Adhesive

Cure Pressure (psi)	*Average Tensile-Shear (psi)*
3.4	3750
7.5	4740
15	5170
40	4730
100	4460

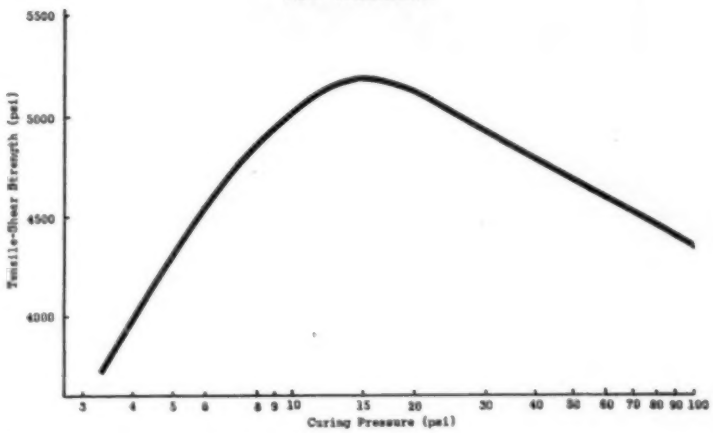
Notes: All lap-shear specimens, using unprimed, 0.064-inch thick, 2024-T3 clad aluminum adherends, were bonded with Epibond 100 adhesive utilizing 0.50-inch overlaps.

Table V—Effect of FM-47 Primer Cure on the Tensile-Shear Strength of Epibond 100 Adhesive

Adherend	*Primer Dried Only*			*Primer Fully Cured*		
	R.T.	*120°F.*	*180°F.*	*R.T.*	*120°F.*	*180°F.*
7075-T6 Aluminum (0.010-inch thick)	------	3290	3860	------	4950	4490
High-Strength Steel (0.008-inch thick)	5610	4580	3720	7100	4920	4550

Notes: FM-47 primer. Epibond 100 adhesive. All adherends were dip-primed in FM-47 primer prior to preparing lap-shear specimens (¼-inch overlaps) with Epibond 100 adhesive. Aluminum adherends were surface-prepared using FPL etch treatment. Steel adherends were surface-prepared using Pre-Bond 700 surface treatment. Adherends after dip-priming were dried for 1 hour at room temperature, followed by 10 minutes at 250°±10°F. Adherends after dip-priming were fully cured (air dried for 1 hour at room temperature, followed by 1 hour at 340°±10°F.).

Figure 2—Tensile Shear Strength Vs Curing Pressure for Epibond 100 Adhesive



Note: Aluminum Adherends (½-in. overlap).

Table VI—Effect of Various Room Temperature Relative Humidity Concentrations on the Tensile-Shear Strength of Epibond 100 Adhesive

Relative Humidity	*Tensile-Shear Strength (psi)*			
	Primer Dried Only		*Primer Fully Cured*	
	Average	*Range*	*Average*	*Range*
Controls (ambient conditions)	5610	3410 - 7420	7100	6320 - 7750
0.0%	5470	3800 - 7210	6950	6080 - 8080
32.3%	6330	3540 - 7690	7750	6720 - 9600
45.0%	6180	4160 - 7620	6910	6000 - 7910
66.0%	5330	3680 - 6270	7010	5600 - 8890
90.0%	5560	4170 - 7200	7070	5700 - 7760
100.0%	5660	4090 - 7280	6530	5600 - 7830

Notes: Epibond 100 adhesive and FM-47 primer were used. High-strength steel adherends (0.008-inch thick) were dip-primed and dried (air-dried for 1 hour at room temperature, followed by 10 minutes at 250°±10°F.) prior to preparing lap-shear specimens. High-strength steel adherends (0.008-inch thick) were dip-primed and fully cured (air-dried for 1 hour at room temperature, followed by 1 hour at 340°±10°F.) prior to preparing lap-shear specimens. All high-strength steel adherends (0.008-inch thick) were surface prepared using Pre-Bond 700 surface treatment. All test evaluations were performed at room temperature.

Acknowledgements

The authors appreciate the help and suggestions given to them by various Aerojet-General Corporation personnel. Our special thanks go to E. L. Rucks, Division Manager, S. R. Wood, M. S. Cole, P. N. Skinner, E. E. Hill, and Mrs. R. D. Drusky.

Adhesives for Coating Discussed at 12th TAPPI Coating Conference

"Adhesives for Coating" was the theme of the 12th Coating Conference of the Technical Association of the Pulp and Paper Industry, held on May 8 to 10, 1961, at the Statler Hilton Hotel in Buffalo, N.Y. R. W. Martinek (Kimberly-Clark) served as general conference chairman. The technical program, consisting of 13 papers and a panel symposium, was under the direction of C. G. Whelpton (Champion Paper & Fibre). Over 900 persons from 22 countries attended the conference.

The panel symposium was on the conference theme "Adhesives in Coating." R. T. Trelfa (Perkins-Goodwin) served as moderator of the panel, which included Dr. F. Frost (S. D. Warren), F. Kaulakis (Consolidated Water Power & Paper), R. H. Mosher (Kimberly-Clark), J. T. Loomer (Continental Can), and W. P. Taylor (Champion Paper & Fibre).

The 13 technical papers were presented at four technical sessions. The session moderators were J. T. Goodwin, Jr. (Corn Industries Research Foundation), A. W. Neubauer (Crown Zellerbach), J. D. Wethern (Riegel Paper), and H. H. Lavery (International Paper). Abstracts of the 13 papers follow:

Adhesion to Fibrous Materials, by J. J. Bikerman (Massachusetts Institute of Technology). Adhesion of coatings or glues to fibrous materials usually is a mechanical (hooking) effect. This is proved, for instance, by the insensitivity of the bond to impurities causing weak boundary layers. The experiment allegedly proving the existence of specific adhesion between glue and fiber can be given a better explanation. In those instances in which no hooking and no embedding occur, the adhesion to fibrous materials is analogous to the adhesion to non-porous solids. The rate of formation and setting of adhesive joints with fibrous adherends is determined by the shape and size of pores in the adherends, their wettability and their tendency to swell, and by the viscosity (or consistency) and the surface tension of the adhesive. These relations can be expressed in quantitative terms.

Some Theoretical Aspects of Adhesion, by T. Alfrey, Jr. (Dow Chemical). The effective adherence of one solid to another depends not only upon the intermolecular forces acting at the interface, but also upon geometrical factors which control the multiaxial stresses in the two media. Of particular interest is the case of a very thin layer of one material adhering to a substrate, or sandwiched between two substrates. In this case, encountered with surface coatings and adhesives, the geometrical factors can be of decisive importance, the consequences can be favorable or unfavorable with regard to over-all performance of the composite structure. Thus, a weak adhesive material may yield a strong joint, or vice versa.

"We believe in starting our new lab people with the basic fundamentals!"

Future Coating Trends, by M. R. Castagne (Pulp & Paper Magazine). Results of a survey on future coating trends were presented. Based upon a questionnaire sent to some 50 coating experts, projections were made on future developments in coated paper and paperboard capacity, on grades which have the greatest growth potential, and on coating equipment, techniques, formulas, pigments and adhesives.

Pre-Cast Clay Coating—a New Process and a New Product, by F. D. Bergstein (Interstate Folding Box). In this new process, a clay-adhesive composition is applied to a metal surface, dried, and then transferred intact onto the base sheet which has been first coated with a film of adhesive. The process has many advantages, including fast drying, simplicity, adaptability to on-or-off machine coating, and ability to coat a wide variety of base stocks. And the end product has many advantages, including high brightness, outstanding gloss, excellent printability, excellent non-fade properties, and adaptability to colors. This program involved extensive research over many years and the new pre-cast coating process and product are fully covered by U. S. Patent 2,934,467 and other patents pending.

Some Techniques for the Assessment of Coated Art Paper, by I. F. Hendry (Wiggins Tape Research and Development Ltd.). The quality of high grade coated art papers is such that it is not possible to make sudden outstanding improvements. Small improvements are often not confirmed by commercial printing trials because of variability in the printing. If a program of research into coated art paper is to succeed, however, small improvements must be detected in order that they can be recognized. The techniques of surface measurement of the sheet and of controlled printing, described in this report, have enabled such small improvements to be perceived.

Coating of Paper in Germany, by M. Judt (Feldmuehle Papier und Zellstoffwerke). This was the first public disclosure of details of coating machinery and techniques in the Feldmeuhle Paper and Pulp Mills Corp., Germany. In a short historical survey, data on machine speeds and machine widths, pre-drying temperatures and daily tonnages at the coating mills of Heidenau, Saxony, and Hillegossen, Westphalia, were given, showing the development of off-the-machine coating in the past thirty years. Raw stock properties and their influence on coater performance, 120-inch wide, were quoted. After presenting comparative data on coated papers made in the United States and in Germany, some differences in quality and approach that have developed were discussed. On-the-machine and off-the-machine qualities were compared, and the future of these techniques and their products in Germany was weighed.

Starch Requirements for Paper Coating, by A. Harsveldt (Nationale Zetmeelindustrie N.V.). One of the most important features of a coating color is water retention. This phenomenon is related to the degree of dispersion of the starch in question and the structure of the starch molecule. Figures have been prepared showing the relationship with degree of dispersion, the method of starch modification and, more specifically, the influence of groups introduced in the starch molecule by oxidation, etherification and esterification.

Rheological Properties and Flow Modifiers for Trailing Blade Coatings, by J. F. Hern (Nopco Chemical). Because the principles of coating with trailing blade equipment differ so vastly from those of the older, more conventional methods, the rheological properties necessary to give a "good" coating color are also quite different using this type of process. It follows, therefore, that additives used to improve the rheological, surface, and printing properties of high solids, trailing blade coatings need to be unique, since their job is to overcome entirely different (although possibly related) problems than those solved by the use of additives in the past. The paper described the role additives may play in altering and improving rheological properties of high solids, trailing blade coating colors, so that higher coat weights, with improved surface and printing properties, can be produced.

Cationic Latex with Controllable Penetration and Set-Off Properties, by E. J. Heiser, A. S. Reder, and R. W. Morgan (Dow Chemical). Research into latices for the paper industry has developed a cationic latex with uniquely different properties. This latex has the ability to chemically set instantaneously into an immobile structure upon exposure to an alkali such as ammonia gas. The dry latex film has excellent water resistance. Pigmented coatings containing this latex show a high degree of picking resistance, calendered gloss, varnish holdout and exceptional wet rub resistance. This paper discussed latex behavior and formulating techniques. It is considered as a binder for pigmented coatings where reactivity to alkali indicates a means of controlling penetration into the coating raw stock, and setoff of wet coating on idler rolls, etc.

D. R. Branaka

Joins American Sealants

American Sealants Co., Hartford, Conn., has appointed Duane R. Branaka as district sales manager for the Michigan and Indiana area. Based in Detroit, he will work with the company's representatives and distributors, coordinating sales of the Loctite brand sealing and locking compound. Mr. Branaka attended the University of Michigan and the Alexander Hamilton Institute. Prior to joining American Sealants, he was associated with the Strand-Steel Corp. and the Warner Electric Brake & Clutch Co.

The Evolution of Coating Preparation in a Bleached Board Mill, by R. W. Bondurant, Jr., and K. E. Bradway (Union Bag-Camp Paper). Solid bleached sulfate board has been coated at Franklin since 1955. The coating preparation system installed initially was a semi-continuous system consisting of a pug mill for clay make-down and blending with adhesives, and a ribbon cooker for adhesives cooking. In 1958, the installation of an air knife coater on a 200 ton per day board machine necessitated increasing coating production. A new system was designed to improve flexibility, eliminate foam and cleanliness problems, and improve blending of the clay slip with adhesives. An addition of a Cowles Dissolver was made in late 1960 to increase production rates to 24,000 gallons per day, improve dispersion, and facilitate handling of auxiliary pigments. The capabilities of each of these systems were discussed.

The Preparation of High Solid Casein Coatings, by H. K. Salzburg, L. E. Georgevits, and W. L. Marino (Borden Chemical). A comparison of the Cowles Dissolver and Baker-Perkins Mixer for preparing casein coatings at 50 per cent to 60 per cent solids was discussed. Methods of controlling viscosity and obtaining water resistance in high solid pigmented coatings were described. These include a study of: the use of dicyandiamide; the effect of pH on viscosity; the use of enzymes; the use of latex. Various caseins modified to obtain low viscosity were also described.

The Use of Polyvinyl Alcohol as a Color Coating Adhesive, by G. P. Colgan and J. J. Latimer (Air Reduction Chemical and Carbide). Polyvinyl alcohol has for many years been known to be an excellent binder for paper coatings. Studies of its use in this application have, however, been few in number, and little specific information concerning the properties of polyvinyl alcohol bound paper coatings has been published. This paper presented the results of studies carried out to characterize the properties of polyvinyl alcohol coating colors and coated paper. The properties of grease resistance and water resistance were also discussed.

A New Multi-Purpose Resin Emulsion for Paper Coating, by A. D. Jordan, Jr., (Rohm & Haas). The properties and typical applications of Rhoplex R-9, an acrylic-modified vinylidene chloride emulsion polymer, were described. Rhoplex R-9 forms coatings with an excellent degree of resistance to water, solvents, abrasion and the passage of water vapor. Certain fundamental properties of Rhoplex R-9 such as the shear modulus-temperature relationship of its films were discussed, and a comparison made with other thermoplastic polymers.

Schenectady Varnish Reorganizes Personnel

Schenectady Varnish Co., Inc., Schenectady, N.Y., has announced organizational changes affecting three marketing and technical positions. Philip H. Groggins, formerly technical sales representative in the Chicago area, has been named sales manager for resins.

All marketing of resins of a non-electrical nature will be under Mr. Groggins' direction.

John S. Horn, formerly field representative for American-Marietta Co., has been appointed to succeed Mr. Groggins in the Chicago area. Mr. Horn will be responsible for technical sales and service for the company's complete line of industrial resins to the adhesive, paint, foundry, paper, printing ink, brake lining, and rubber industries.

George Brannick, formerly associated with Varcum Chemicals, a division of Reichhold Chemicals, Inc., has been named to the newly-created position of manager, technical service for resins. He will direct the technical service program staff on all resins of a non-electrical nature.

Mr. Groggins graduated from Cornell University with a B.S. degree in chemistry. He has been with the company since 1951. Prior to his present appointment, he served as sales development supervisor in the home office, as well as technical sales representative in Chicago.

Mr. Horn holds a B.S. degree in physics from the University of Chicago, and is a co-holder of two patents dealing with the shell mold process. He has had over 15 years of technical sales experience with the paper, foundry and other related resin utilization industries. Mr. Brannick graduated from Michigan State University with a B.S. degree in chemistry. He joined Schenectady in 1960 as a research development chemist.

• Eastman Chemical Products, Inc., 260 Madison Avenue, New York, N.Y., has available a 15-minute, 16mm motion picture which describes its bonding agent, Eastman 910 Adhesive.

Thomas Barker

Represents Amsco

American Mineral Spirits Co., Chicago, Ill., has appointed Thomas Barker as Midwest sales manager. He will be responsible for the sales of Amsco's complete line of petroleum solvents, technical naphthas, and waxes, from western Pennsylvania to the Rockies, and from western Canada to the Mexican border. Mr. Barker holds a B. S. degree in chemistry from the University of Miami. He joined the company in 1950 as a sales representative in the Southern Division, later becoming manager of the Mid-South Division. In 1956, he was transferred to Chicago as manager of Amsco's special products sales, the post he has held up to his present appointment.

Offers Water-Proof Film

Sun Chemical Corp., Wood River Junction, R.I., is marketing a new air-drying solvent solution which, the company reports, substantially increases the resistance of paper and paperboard products to water and weathering. Developed by the Paper Chemicals Department of the Warwick Chemical Division, the product, called Impregnole 367, is a mixture of General Electric silicone polymers and other film-forming ingredients. It is designed to be used diluted in solvent to approximately 5 to 10 per cent solids, and is applied by spraying or swabbing, followed by air drying. The material is also said to be noncorrosive.

Program Set For Glues Division Meeting

The Division of Glues and Gluing Processes of the Forest Products Research Society will hold a business meeting on June 20, 1961, at the Kentucky Hotel, Louisville, Ky., during the annual meeting of the FPRS, being held from June 18 to 22. Richard F. Blomquist (Forest Products Laboratory), chairman of the division, has prepared a tentative 10-point agenda of items to be discussed at the division meeting. The 10 points are:

(1) the need for better methods of translating research information so that industry can put it into immediate use

(2) the development of an action program for each of the subdivisions

(3) determine the proper place of the veneer and plywood group

(4) determine ways to improve technical sessions at future meetings

(5) determine a program of research needs and objectives in wood gluing research

(6) determine means to promote better gluing practices in industry

(7) plan future division activities on surveys, reports, abstracts, and bibliographies

(8) determine what gluing can do to help the wood industry meet competition

(9) plan a program of quality control and process control in gluing

(10) election of division officers.

FMC Hits Record Quarter

First quarter sales and earnings of Food machinery & Chemical Corp. reached record levels with sales soaring to $91,449,785 from the $76,988,230 in the comparable 1960 period. Net income for the quarter ended March 31 increased to $4,450,447, or 62¢ a share, from $3,918,095, or 55¢ a share, in the same period a year earlier. More than half the sales increase was attributed to Food Machinery's overseas business, including International Machinery Corp. of Belgium.

Manufacturers Advised On Labeling Act

The Food and Drug Administration of the U.S. Department of Health, Education and Welfare has advised manufacturers of household aids of the type of labeling that may be required under the new Federal Hazardous Substances Labeling Act. The FDA published the first proposed regulations for enforcement of the new law in the Federal Register. Interested persons may present their views on the Labeling Act on or before June 28, 1961, in writing to the Hearing Clerk, Department of Health, Education and Welfare, 330 Independence Avenue, S.W., Washington 25, D.C.

The effective date of the enforcement provisions of the law has been extended to August 1, 1961, except for products which are highly toxic, extremely flammable, and flammable. The new law requires that special precautionary labeling must include the common, usual, or chemical name of the hazardous substance or of each component contributing significantly to the hazard; the signal word "Danger" on substances which are extremely flammable, corrosive or highly toxic; the words "Warning" or "Caution" on all other hazardous substances.

Proposed Regulations

The proposed regulations would require, among other things, that:

(1) The label information appear on the main panel or in proximity to the principal elements within the borders of a square or rectangle.

(2) The borderline and required information be in a color that is in strong contrast with the background color of the label.

(3) The precautionary wording be in uncondensed Gothic capital letters with the signal words "DANGER", "WARNING", or "CAUTION" and "POISON" in 30 point type, or type as large as the largest type appearing elsewhere on the label.

(4) When accompanying literature includes any directions for use, it must also bear the precautionary information required on the container label.

J. D. Russo

W. F. McGowan

Appointed by National Starch

National Starch & Chemical Corp., New Nork, N.Y., has announced the appointment of Joseph D. Russo as supervisor of its San Francisco Technical Development Laboratory, and of William F. McGowan as New York district sales representative for its National Adhesives Division. Mr. Russo received his B.S. degree in chemistry from St. John's College in 1956. Upon graduation, he joined National Starch at the Alexander Laboratories in Plainfield, N.J. He was transferred to San Francisco in 1958. Mr. McGowan is a graduate of St. Francis College. He formerly worked at the Atlanta office.

Ciba Develops Hardener

Araldite DP-125, a hardener designed specifically for use with Ciba flexible epoxy resins, is available in sample quantities from Ciba Products Corp., Fair Lawn, N.J. The new hardener is a low-viscosity, modified polyamine, developed for curing Araldite DP-437 flexible epoxy resin or blends of DP-437 and other liquid epoxy resins. The company states that systems employing the new hardener can be cured at room or elevated temperatures. Some of the advantages claimed for DP-125 are low initial viscosity of resin-hardener mix (1000-1500 cps.), excellent elongation properties with good tensile strength, excellent resistance to age hardening (unaffected after 90 days at room temperature), and similar end properties resulting from systems cured at room temperature or at 100°C. Recommended applications include adhesives, caulking, electrical potting, and impregnating.

Record Borden Quarter

The Borden Co. has reported record first-quarter levels for sales and earnings, accomplished in the face of a particularly good showing in the comparable period of 1960. First quarter earnings reached $5,600,535, or 56¢ a share, compared with $5,445,618, equal to 55¢ a share in the first quarter of 1960. Sales were reported at $238,624,856, up from $230,012,995 in the similar period a year ago. An encouraging recent pick-up in chemicals was held partly responsible for the rise, offsetting earlier declines in operations resulting from adverse weather conditions and the general industrial slack-off.

Harold W. Comfort, president of Borden, stated, "In view of our showing in the first quarter, and since it appears that the national economy has bottomed out and is experiencing a slight upward trend, I am confident our results for all of 1961 will be another record."

George Collons

Jerry Zalkind

In New Kleen-Stik Posts

George Collons, vice-president of Kleen-Stik Products, Inc., Chicago, Ill., formerly in charge of Eastern operations, has been appointed general sales manager. In the past, the company's sales activities have been under the direct supervision of Jerry Zalkind, executive vice-president, in addition to his other management responsibilities. The appointment of Mr. Collons as general sales manager was made to permit Mr. Zalkind to devote more time to the development of new markets and new products, the company announced. Mr. Collons, formerly located at Kleen-Stik's New York offices, will now be headquartered at the company's executive offices in Chicago.

National Starch Earnings

National Starch & Chemical Corp. reports that its net income for the quarter ended March 31 amounted to $758,301, equal to 36¢ per share of common stock, compared with $759,003, or 37¢ per share, for the like period in 1960. Net sales for the first quarter totaled $14,991,966, compared with $13,429,231 in the 1960 period.

New Arabol Plants

Arabol Manufacturing Co., New York, N.Y., is expanding its operations with the addition of new plants in Delaware, Ohio, and Portland, Ore. The Delaware facility went on stream in January, 1960, and is producing some 200 adhesives. The plant covers 20,000 square feet in area. The Portland facility, with 12,000 square feet, is expected to go on stream by mid-1961.

3M in Vienna

Minnesota Mining & Manufacturing Co., St. Paul, Minn., has formed a wholly-owned sales subsidiary in Vienna, Austria, known as Minnesota "3M" Technische Vertriebs, GmbH. The organization, headed by Ernst Bernhard, formerly a regional sales manager for 3M in the European area, will handle the sales of all 3M products in Austria.

Borden Names O'Connor

John J. O'Connor has been appointed by the Borden Chemical Co., New York, N.Y., to head its newly-formed International Division. Mr. O'Connor had been vice-president of the former International Department. In his new position, he will be responsible for the operations of Borden's 11 overseas companies.

Building Use Seen For Epoxy Adhesives

Epoxies, claimed to be stronger than steel studs when used to bond together sections of bridges and buildings, can provide greater resistance to repeated loadings, reports Dr. Gene M. Nordby, head of the Department of Civil Engineering at the University of Arizona, Tucson, Ariz. Dr. Nordby cites a test made by the department's Structural Engineering Department, in which a 4 by 21 foot composite bridge beam was constructed of a 1,050 pound steel beam affixed with epoxy to the bottom of a 4,500 pound concrete slab. Hydraulic jacks, attached to a steel frame surrounding the test beam, applied a load of 140,000 pounds before the beam cracked.

According to Dr. Nordby, other tests made at the school's Engineering Experiment Station indicate that precast concrete and steel beams and columns offer a potential substitute for pouring concrete into forms built around steel superstructures at construction sites.

This technique, Dr. Nordby notes, may revolutionize the building industry and reduce construction costs. All parts of a building may be precast and bonded together at manufacturing plants and then shipped to the construction sites for assembly.

Micarta Group Meets

The Micarta Fabricators Association, sponsored by the Micarta Division of Westinghouse Electric Corp., Hampton, S.C., held its second annual meeting on April 18 to 20 at Hilton Head Island, S.C. The seminar-type meeting featured discussions of fabricator methods, product engineering, marketing, and research in the use of industrial plastics. Discussion leaders included Westinghouse engineering and sales personnel, as well as spokesmen for the fabricators.

The MFA includes 25 of the major industrial plastics fabricators in the country. Members are furnished with technical data by the Westinghouse research and engineering counsel.

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Adhesives Displayed At Packaging Show

More than 32,000 visitors viewed displays showing the latest in adhesives, tapes, packaging machinery, materials, supplies, containers, and services, which were exhibited by 372 firms at the American Management Association's 30th National Packaging Exposition, held on April 10 to 13, 1961, at Lakefront Exposition Hall in Chicago, Ill. Running concurrently with the first three days of the Exposition was the AMA, National Packaging Conference with its theme being "The Power of Packaging." Other topics discussed at the conference were "Industrial Goods Packaging," "Consumer Goods Packaging," and "The Profiles of Packaging."

Products Demonstrated

At the Packaging Exposition, adhesives and adhesive products for use in packaging were displayed by their manufacturers. The Marathon Division of American Can Co., Menasha, Wisc., featured its new Marabond heat-sealing label that is said to adhere to wrapping materials of all kinds, including waxed surfaces. Arabol Mfg. Co., New York, N.Y., had a display of specification adhesives designed for minimum cost and maximum efficiency.

Avery Label Co., Monrovia, Calif., demonstrated its latest pressure-sensitive labeling materials, processes, techniques, and equipment. Behr-Manning Co., Troy, N.Y., displayed its line of Bear tapes for packaging use. Bemis Bro. Bag Co., St. Louis, Mo., exhibited the latest in its line of self-adhesive papers produced by its Morgan Adhesives' subsidiary, as well as label stock and equipment for dispensing pressure-sensitive materials. Brown-Bridge Mills, Inc., Troy, Ohio, featured its line of heat-seal papers, Pancake all-weather gummed papers, Striptac pressure-sensitive label papers, and Red Streak gummed tapes.

Eastman Chemical Products Inc., New York, N.Y., demonstrated the use of its hot-melt adhesives, including a pelleted Epolene blend being marketed under the designation of A B Hot Melt. F. G. Findley Co., Milwaukee, Wisc., had a joint exhibit with Southern Adhesives Corp. and Union Paste Co. which featured a wide range of packaging and converting adhesives. H. B. Fuller Co., Milwaukee, Wisc., exhibited specific adhesive products to be used for a variety of packaging applications.

Ideal Tape, Inc., Lowell, Mass., presented its regular line of industrial pressure-sensitive cloth and paper-backed tapes, and a new glass-reinforced paper strapping tape. Jackmeyer Corp., New York, N.Y., displayed a new Stik-On blister coated with pressure-sensitive adhesive and applied with hand pressure. Kleen-Stik Products, Inc., Chicago Ill., demonstrated its new, improved Label-Aire label applicator which operates on an air-jet principle, and displayed its complete line of pressure-sensitive adhesive label stock.

Labels & Decals, Inc., Chicago, Ill., displayed its line of pressure-sensitive and heat-seal labels. Manhattan Adhesives Corp., Brooklyn, N.Y., showed samples of adhesives for use with vinyls and plastics, as well as fast-setting glue-lap resins, blister package adhesives, casein iceproof label glues, strip-stamp adhesives, and hot melts for impervious surfaces and various types of contact cements.

Minnesota Mining & Mfg. Co., St. Paul, Minn., displayed a line of adhesives and adhesive products manufactured by its Industrial Tape Division, Chemical Division, Printing Products Division, and Derby Sealers Division. Morningstar-Paisley, Inc., New York, N.Y., exhibited new high-speed adhesives for all packaging operations, including a new fast-setting, odor-free packaging adhesive meeting FDA regulations. Mystik Adhesive Products, Inc., Chicago, Ill., had on display its line of pressure-sensitive packaging tapes, including strapping, rope stock and cloth tapes as well as high-temperature tapes for aircraft and missile applications.

National Starch & Chemical Corp., New York, N.Y., showed its Instant-Lok hot-melt adhesive extruder system; Easi-Clean multipurpose resin adhesive; foil laminating and flexible packaging adhesives; and Resyn 3600, a new water-dispersion polyvinylidene chloride resin. Permacel, New Brunswick, N.J., had an exhibit which utilized recorded telephone messages synchronized to rotating back panels describing its line of pressure-sensitive tapes, adhesives, and dispensers used in all types of packaging applications.

Literature Distributed

Pyroxylin Products, Inc., Chicago, Ill., distributed literature describing lacquer and hot-melt packaging materials as they are used in adhesives and protective coatings. Simon Adhesive Products Corp., Long Island City, N.Y., gave a demonstration of automatic conversion of its Eze-Stik roll label stock into die-cut finished labels, and exhibited several highly decorative pressure-sensitive materials based on metallized Mylar and Mylar-vinyl laminates.

Stein, Hall & Co., New York, N.Y., displayed a comprehensive line of adhesives for all types of packaging, as well as adhesives with special characteristics with emphasis on newer types of resin emulsion adhesives. Tompkins Label Service, Philadelphia, Penna., exhibited labels in actual use on hundreds of diversified products and packages, including pressure-sensitive, heat-seal, bag-header, and continuous roll labels, gummed and ungummed, for use with all types of automatic labeling equipment.

"Sorry, Mumbley, we can't use that new adhesive you developed —it doesn't hold up under concentrated stomach acid!"

R. C. Gill

Joins Franklin Glue

Robert C. Gill, formerly in charge of wood adhesives development and technical service for the Peter Cooper Corp., has been added to the staff of the Franklin Glue Co., Columbus, Ohio. Mr. Gill graduated from Duke University with a B.S. degree in chemistry, and received a Master of Forestry degree in wood technology there in 1950. He has been a trustee of the Northeast Section of the Forest Products Research Society, and has written many trade articles and technical bulletins on wood adhesives. Mr. Gill is a member of ASTM Committee D-14 on Adhesives.

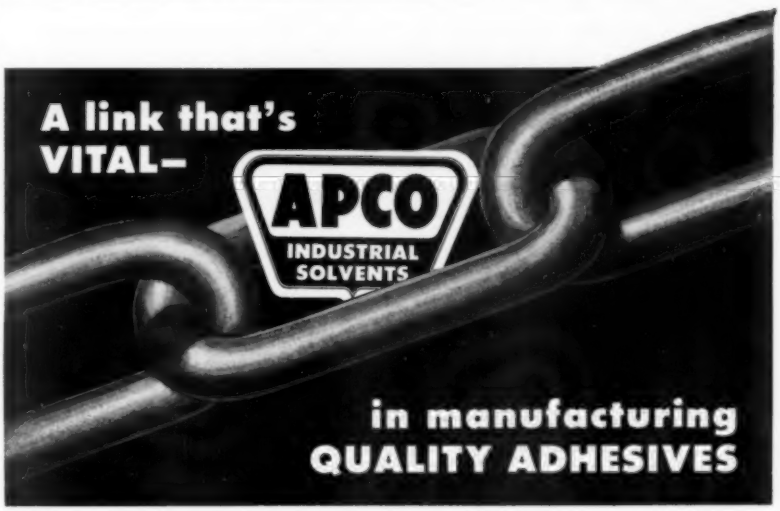
Develops CoRezyn Resins

Three new polyester resin materials to be used as tackifiers and for applications in adhesive hot melts, or adhesive components, have been developed by Commercial Resins Corp., St. Paul, Minn. The three unsaturated orthophthalic and isophthalic polyester resins are CoRezyn 1, 2, and 3.

CoRezyn 1 is a thermoplastic, water white, solid, unsaturated orthophthalic polyester resin, monomer-free. It melts at 120° to 130°F., and has an acid value of 35 to 40. CoRezyn 2 is a thermoplastic, light yellow, solid, unsaturated, isophthalic polyester resin, monomer-free. It has a higher melting point than CoRezyn 1, and lower acid value. CoRezyn 3 is a heavy, viscous liquid, amber in color, unsaturated polyester resin, monomer-free, recommended for plasticizing CoRezyn 1 and 2.

Pemco Names Walter

Pemco Adhesives, Inc., Auburn, Indiana, has elected Frederick A. Walter as vice-president for research and development. He will be in charge of developing new industrial adhesive products. Mr. Walter received his B.S. degree in chemical engineering from Wayne State University in 1943. After graduate studies at the University of Michigan, he joined the U. S. Rubber Co. in Detroit in the Development Department. During World War II, he served in the Chemical Warfare Service, after which he returned to U. S. Rubber as a senior engineer in the Mechanical Goods Division. When the division moved to Fort Wayne, Ind., in 1948, he transferred with it, later becoming senior physicist. In 1958, Mr. Walter left U. S. Rubber to teach physics for one year at Indiana Technical College. He had been attending Purdue University for advanced work in physics and mathematics until his acceptance of the Pemco position.



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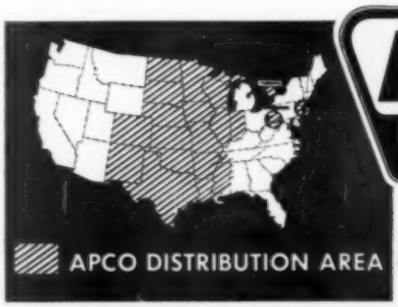

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Airco Names Five

Air Reduction Chemical & Carbide Co., New York, N.Y., has filled five marketing positions in its Colton Polymers Department. R. C. Gilardi, W. F. Lehr, and J. V. Kaine were named district managers; S. E. Werner was appointed branch manager, and D. M. Stettler was named national accounts representative.

Mr. Gilardi, formerly district manager in the Chicago office of the Air Reduction Chemical Co., one of three recently-consolidated divisions of Air Reduction Co., Inc., has been named manager of the Western district. He will be headquartered at City of Industry, Calif., near Los Angeles. Mr. Lehr, formerly sales representative for Air Reduction Chemical, has been promoted to Eastern district manager. His offices will be at Clermont Terrace, Union, N. J.

Mr. Kaine, who held a sales post with the former Colton Chemical Co., one of the three recently-consolidated Airco divisions, becomes manager of the Central district. He will be located in Cleveland, Ohio. Mr. Werner, who also held a sales post with Colton Chemical, has been appointed branch manager at Tampa, Florida. Mr. Stettler, formerly national accounts representative for Colton Chemical, has been named national accounts representative for the new Colton Polymers Department. He will cover New York State. with offices located in New York City.

Reichhold Expands

Reichhold Chemicals, Inc., White Plains, N.Y., has contracted with Air Products, Inc., for the principal output of a new plant which will produce oxo alcohol. The new unit is to be constructed by Tidewater Oil Co. next to its Delaware refinery. Reichhold also plans to install new equipment for the manufacture of plasticizers at its Detroit plant, and some of its plants located in California and on the East Coast, to make use of the Delaware unit's production. The company states that its increased demand for oxo alcohol is the result of a 100 per cent rise in the manufacture of plasticizers by its Deecy Products Division.

Epoxy-Silicone Rubber

Eccosil, an epoxy-silicone rubber combination material for potting, impregnating, caulking, and molding applications, has been developed by Emerson & Cuming, Inc., Canton, Mass. The new family of easily pourable materials is said to capture the best features of silicone rubber and epoxy resins. The family also includes general purpose and lightweight room temperature vulcanizing silicone rubber compounds. Materials currently available are Eccosil 4850, used for potting, caulking and mold making, Eccosil 4640 for airborne applications, Eccosil 4712 for potting applications, and Eccosil 4520 for impregnating and dip-coating.

Shawinigan Offers Resin

A fine particle size polyvinyl acetate-multipolymer latex, said to impart a higher degree of stiffness and rigidity to treated materials than can be obtained with unmodified polyvinyl acetate emulsions, has been developed by Shawinigan Resins Corp., Springfield, Mass. Designated Resin D-809, the new emulsion is reported to be unique among polyvinyl acetate emulsions, because it does not form a continuous film when dried at room temperatures, but must be subjected to moderate heat treatment in order to coalesce the resin. According to the company, continuous fused films of Resin D-809 have superior scrub resistance, excellent water spotting resistance, possess good wet strength after prolonged immersion in water, and excellent adhesion to a variety of surfaces.

Adhesives Group Meets

The Adhesives Testing Committee of the Technical Association of the Pulp and Paper Industry met on May 3, 1961, at Tappi headquarters in New York City to discuss adhesive monographs being written by members. The subjects of the monographs discussed included: solvent adhesives; dextrines; foil laminating adhesives; casein adhesives; tack testing; amine glues; resin emulsion adhesives; pressure-sensitive adhesives; pregummed water remoistenable adhesives; and hot-melt adhesives.

"Good . . . We're just in time to witness a tensile strength test."

Hercules Resin Unit Open

Newly completed facilities of the Hercules Powder Co. at Hercules, Calif. are now producing three urea-formaldehyde concentrates in commercial quantities. The three products are UFC 7626, UFC 7147, and UFC 8545, differing in the content of formaldehyde and urea and solids content. The three initial concentrates of an expected wide range of urea-formaldehyde concentrates are designed for the manufacture of many types of urea-formaldehyde resins for a variety of industries on the West Coast, including plywood adhesives, furniture, paper, particle board, textile and protective coatings.

RCI Maleic Plant Open

The new maleic anhydride plant of Reichhold Chemicals, Inc., has gone on stream at Elizabeth, N.J. The $4 million plant has a design capacity of 20 million pounds per year, making it one of the largest plants of its type ever constructed.

Stein Hall Offers Shares

Stein, Hall & Co., New York, N.Y., heretofore a privately-owned company, is offering to sell 250,000 shares of common stock to the public. The offering is being handled by an underwriting group headed by F. Eberstadt & Co., and will leave two thirds of the company's 751,580 shares outstanding in the hands of present owners. Last year, Stein, Hall earned $878,000, or $1.17 a share, on sales of $56.8 million. The year before, it reported a net income of $735,000, or 98¢ a share, on sales of $59.3 million.

U.S. Borax Sales Up

Sales at U.S. Borax & Chemical Corp. rose to $32,838,168 for the six-month period ended March 31, 1961, from $32,625,707 in the same period a year ago. The company reports that higher advertising costs cut net profit which amounted to $2,732,718, equal to 58¢ a share, compared with $3,298,921 for the comparable period a year earlier.

Record Corn Quarter

Corn Products Co. reports that its sales and earnings for the first quarter of 1961 were the best in its history with sales totaling $172,650,818, compared with $165,383,494 for the same period in 1960. Net income for the quarter ended March 31 was $9,010,766, equal to 82¢ per share, compared with $8,738,212, or 80¢ per share, a year earlier. At its recent annual meeting, stockholders approved a proposal to increase the authorized capital stock to 30 million shares from 15 million to coincide with a 2-for-1 stock split, which became effective on May 2, 1961.

M-P Sales Increase

Sales in 1960 for Morningstar-Paisley, Inc., totaled $25,480,011, a slight increase over the 1959 figure of $25,262,997. The firm's net income for 1960 amounted to $583,882, equal to $1.14 per share of common stock, compared with $663,904, or $1.30 per share for the previous year.

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Carton Volume Off

The Folding Paper Box Association of America reports that shipments of folding cartons during the first quarter of 1961 declined 5.3 per cent from the comparable period last year, with decreases from 3 to 9 per cent in dollar volume in each of the three months. Tonnage was off similarly. Quarterly shipments were $12.2 million below the same period last year, with tonnage off by more than 30,000 tons. Industry volume is estimated at $220.8 million, with 547,100 tons shipped. Average volume per ton of folding cartons amounted to $403 in the first quarter, the same level recorded for the first quarter of 1960.

New orders for folding cartons were off by 5.7 per cent in dollar volume and 5.4 per cent in tonnage, with an upturn in orders recorded for March. March shipments totaled $82 million, compared with $84.9 million a year ago. A total of 203,000 tons were shipped during the month, compared with 210,500 tons in March, 1960.

Isochem Novalac Resin

A new low viscosity epoxy Novalac resin, developed by Isochem Resins Co., Providence, R.I., is said to combine low viscosity, high heat stability, higher heat distortion, and better adhesion, plus a tightly cross-linked system that yields chemical stability and freedom from degradation in use. Called Isochemrez 460, the liquid resin reacts completely with catalysts, according to Isochem, leaving no residual phenolic hydroxy to limit stability. In addition, Isochemrez 460 will not degrade under prolonged high temperature operation, and offers superior resistance to acetone, ethylenedichloride, alcohols and most degrading chemicals.

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Seal-Kap Sales Up

American Seal-Kap Corp. sales in 1960 reached an all-time high of $41,566,234, a 25.2 per cent increase over the 1959 figure of $33,279,951. Net income in 1960 after taxes and provision for minority interests was $644,024, compared with $1,028,324 in the previous year. According to E. M. Black, Seal-Kap president, the decrease in earnings reflected the additional costs and expenses involved in adding several strategically located new plants, improving the efficiency of existing facilities, and introducing a number of new products. During 1960, $1,300,000 was spent in capital improvements, exclusive of acquisitions, and over $650,000 was spent in research and development and in the promotion of new products. In 1960, Seal-Kap acquired the Paper Container Division of Potlatch Forests, Inc.; purchased all of the capital stock of the Herz Companies; and began operations in two new facilities, one in Compton, Calif., and the other in Toronto, Ontario, Canada.

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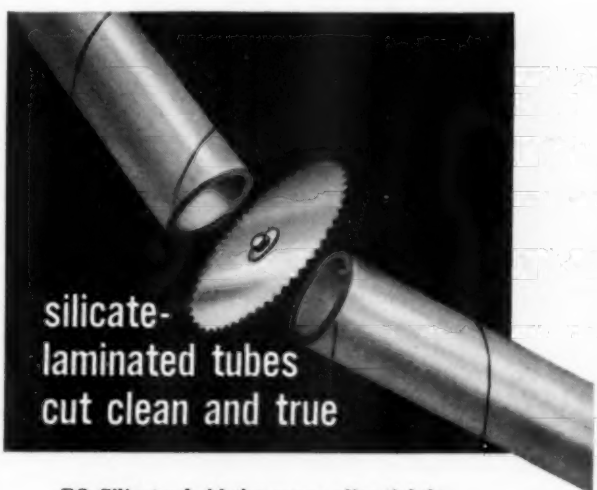

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names in the news

Raymond J. Bilski has been named sales representative in Michigan for the Industrial Chemicals Division of Stauffer Chemical Co., Detroit, Mich.

Thomas Bradshaw has joined the formulation group of the Niagara Chemical Division of Food Machinery & Chemical Co., New York, N.Y. *Richard P. Stanovick* has been named analytical chemist in the residue analysis group.

Dr. William T. Cave has been named assistant director of analytical chemistry at the research center of Monsanto Chemical Co., St. Louis, Mo.

Dr. Helmuth W. Schultze has been appointed manager of catalysts at the Nuodex Products Division of the Heyden Newport Chemical Corp., New York, N.Y.

Robert P. Carlson has been transferred from the Sales Department to the Technical Service Department at Shawinigan Resins Corp., New York, N.Y.

George M. MacLeod has joined the Inorganic Chemicals Division of Monsanto Chemical Co., St. Louis, Missouri.

Stanley A. Mattison has been appointed director of public relations for Hooker Chemical Corp., Niagara Falls, N.Y.

Dr. Eugene W. K. Schwarz, president of Schwarz, Inc., has been named president of the Association of Consulting Chemists and Chemical Engineers, Inc.

Royal A. Brown has been appointed manager of coatings production for Stanley Chemical Co., East Berlin, Connecticut.

A. Richard Quinn has been named sales representative in the midwest area for the Chemicals and Plastics Division of Food Machinery & Chemical Corp., Cleveland, Ohio.

Edward J. Finn, Jr., formerly superintendent of the central shops and utilities branch of the Bonded Abrasives Division of the Carborundum Co., has been promoted to manager of the division's Engineering Design Department.

Bruce S. Bernstein, formerly with the National Starch and Chemical Corp., and *Ernest George Kramer*, formerly with Roux Laboratories, have joined Radiation Applications, Inc., New York, N.Y., as research chemists. *Richard Everett, Jr.*, formerly with the Service Engineering Division of the Air Materiel Command, Rome Air Materiel Area, Griffiss Air Force Base, has joined the company as research engineer.

Robert E. Vidal, formerly manager of resin sales, has been named manager of the Greensboro Division of Dow Corning Corp., Midland, Mich.

Charles R. Widder, formerly an engineer in plastics development and customer service for B. F. Goodrich Chemical Co., has joined the plasticizer group of the central research laboratory of Archer-Daniels-Midland Co., Minneapolis, Minn.

Albert S. Landers, previously associated with Scott Paper Co., has joined the headquarters staff of the Technical Association of the Pulp and Paper Industry, New York, N.Y., as supervisor of technical information.

Francis Person, Jr., previously associated with Koppers Co., Inc. as senior technical representative in the fine chemicals market section, has joined the A. E. Staley Mfg. Co., Decatur, Ill., as a section head in the Industrial Market Development Department.

Dr. Donald L. Esmay has joined the Minnesota Mining & Mfg. Co., Minneapolis, Minn., as senior research chemist.

Dr. Luther S. Roehm, formerly a vice-president of A. E. Staley Mfg. Co., has been elected vice-president of marketing for the Chemical Division of Merck & Co., Inc., Philadelphia, Penna.

T. C. Yao has joined the research center staff of the Shell Development Co., Emeryville, Calif., as a chemist in the Analytical Department.

Don Phillips has joined Dees Adhesive & Chemical Co., Dalton, Ga., as chemist.

Roy D. Wiggins has joined the southern district of Ciba Co., Charlotte, N.C., and *Donald A. Gardner* has been named technical representative, working out of that office. *A. R. Thompson* has retired after 27 years of service with the firm.

Carl R. Erikson, director of research for Arabol Manufacturing Co., New York, N.Y., has been assigned the additional post of manager of the Brooklyn Division, succeeding *John J. Sokolinski*, who has retired.

Robert E. Cochran has been named assistant manager of sales for the Chlor-Alkali Division of Food Machinery & Chemical Corp., New York, N.Y.

William E. Lowery has joined the Applied Plastics Division of Hexcel Products, Inc., El Segundo, Calif., as technical representative.

Dr. Alan B. Gancy has been appointed supervisor of the physical chemical section in the Inorganic Research and Development Department of the Chemicals Division of the Food Machinery & Chemical Corp., New York, N.Y.

William M. Clark has been named sales manager for the southern district of the Chlor-Alkali Division of Food Machinery & Chemical Corp., with headquarters in Charlotte, N.C.

William C. Buffing, Jr., treasurer of National Starch & Chemical Corp., New York, N.Y., has been elected a vice-president of the company.

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June 5-7. American Society for Quality Control, Annual Convention and Exhibition, Sheraton Hotel, Philadelphia, Penna.

June 5-8. Instrument Society of America, Instrument-Automation Conference & Exhibit, Royal York Hotel, Toronto, Ont., Can.

June 5-9. Society of the Plastics Industry, National Conference, Hotel Commodore, New York, N.Y.

June 7-8. Laminated Foil Manufacturers Association, Virginia Beach, Va.

June 7-9. Paper Industry Management Association, National Meeting, Robert Meyer Hotel, Jacksonville, Fla.

June 9-17. European Congress of Chemical Engineering and 13th Exhibition-Convention of Chemical Apparatus, Frankfurt, West Germany.

June 11-15. American Society of Mechanical Engineers, Summer-Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

June 16-25. International Plastics Exhibition, Europlastica 61, Ghent, Belgium.

June 18-22. Forest Products Research Society, Annual Convention, Kentucky Hotel, Louisville, Kentucky.

June 19-23. Massachusetts Institute of Technology, Plastics Research Institute Course on "The Technology of Reinforced Plastics," Cambridge, Mass.

June 20-29. Italian Packaging Institute, International Biennial Packaging & Packing Exhibition, Fairgrounds, Milan, Italy.

June 21-24. Rubber & Plastic Adhesive & Sealant Manufacturers Council, Summer Meeting, Greenbriar, White Sulphur Springs, West Va.

June 21-July 1. Sixth International Plastics Exhibition & Convention, Olympia, London, England.

June 25-30. American Society for Testing Materials, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N.J.

June 26-27. American Vacuum Society, 5th Annual Conference on Vacuum Metallurgy, University Heights Campus, New York University, New York, N.Y.

June 26-30. Massachusetts Institute of Technology, Plastics Research Institute Course on "The Science of Adhesion," Cambridge, Mass.

June 27. ASTM Committee C-24 on Joint Sealants, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N.J.

June 27-30. ASTM Committee D-11 on Rubber and Rubber-Like Materials, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N.J.

July 3-7. Gordon Research Conference on Polymers, Colby Junior College, New London, N.H.

July 17-21. Gordon Research Conference on Elastomers, Colby Junior College, New London, N.H.

July 17-21. Gordon Research Conference on Organic Coatings, Kimball Union Academy, Meriden, N.H.

July 24-28. Gordon Research Conference on Chemistry at Interfaces, Kimball Union Academy, Meriden, N.H.

Aug. 28-Sept. 1. Gordon Research Conference on Adhesion, New Hampton School, New Hampton, N.H.

Portrait of

STEVEN YURENKA

Manager of the Engineering Research Department at Narmco Research & Development, San Diego, Calif., Steven Yurenka is responsible for the technical direction of exploratory structural analysis, materials application, and testing activities for a number of military research programs. A member of ASTM's Committee D-14 on Adhesives, he was recently elected Chairman of the West Coast Subcommittee on Structural Adhesives.

On graduating from the University of Illinois in 1943, Dr. Yurenka worked briefly for Allis Chalmers, the Navy Department and the Naval Research Laboratory prior to entering M.I.T. for a doctorate in mechanical engineering. His thesis on one phase of plastics resulted in a universal testing machine and many associated devices which have become models for the industry.

In 1951, Dr. Yurenka went to work as a research engineer for Douglas Aircraft Co. and was in charge of activities associated with adhesive bonding, honeycomb sandwich construction, and high temperature testing. He accepted his present position at Narmco in 1958.

Author and co-author of several articles on adhesives and plastics, Dr. Yurenka is active in groups dealing with testing and properties of non-metallic structural materials.

G-E Silicone Fluids

The Silicone Products Department of General Electric Co., Waterford, N.Y., has developed a new class of nitrile-containing silicone fluids. The company reports that the presence of nitrile groups in

New nitrile-containing silicone fluid grade, developed by General Electric, is shown to maintain complete integrity when poured into toluene solvent in test demonstrating solvent resistance of material.

the fluids gives them high polarity and results in such properties as solvent resistance, limited electrical conductivity, and high dielectric constant.

The N.S. (nitrile silicone) Fluids are similar to dimethyl silicone fluids in that they have low surface tension. The dielectric constants of N.S. Fluids can range from approximately 3-20 at 60 cycles, the company states. The high polarity of the nitrile group gives them insolubility in non-polar solvents such as aliphatic and aromatic hydrocarbons. These fluids are soluble in certain polar solvents, such as alcohols, ketones and ethers, making them valuable where oil and solvent resistant fluids are desired.

Other characteristics of these fluids include hydrolytic stability, thermal stability, electrical conductivity, surface tensions ranging between approximately 23-27 dyne/cm., and relatively no toxicity. Possible uses suggested for the new class of fluids are as non-aqueous antifoams, base stocks for solvent resistant greases and coatings, antistatic agents, and as plasticizers and additives for plastics.

Hexcel Reports Earnings

Net earnings at Hexcel Products Inc. for the first quarter of 1961 amounted to $16,751, or 7¢ per share, compared with net earnings of $38,953, or 16¢ per share, for the same period of 1960. Sales for the first quarter of 1961 were $1,533,113, against $1,625,487 for the first quarter of 1960. The company points out, however, that the first quarter sales and profits have shown an increase from the fourth quarter of last year.

Offers Stonclad Flooring

Stonhard Co., Philadelphia, Penna., has introduced a new surfacing material, called Stonclad, which is designed for extra heavy duty floorings for industrial use. Stonclad is a dense, non-porous, self-curing plastic surfacer which cures quickly after application because it hardens by polymerization rather than hydration. The company reports that it bonds tenaciously to the base to which it is applied.

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New Allen Adhesive

Alweld Fire-Resistant Adhesive for bonding treated, fire-resistant wood, has been developed by Allen Plastics Corp., New York, N.Y. The company reports that wood bonded with Alweld can be charred to the point of disintegration without breaking the adhesive bond. The new bonding agent is also resistant to extended submersion in fresh or salt water. It is recommended by the company for bonding wooden arches and trusses, as well as other structures where wood must meet building code requirements.

Rohm & Haas Plasticizer

A new low-temperature plasticizer for polyvinyl chloride is available from Rohm & Haas Co., Philadelphia, Penna. The new plasticizer, called Monoplex S-74, is a monomeric epoxy ester said to provide decreased volatility while maintaining good low-temperature flexibility and the ability to impart heat and light stability to polyvinyl chloride. In addition, resistance to extraction by soapy water is reported to be substantially improved. The company also claims that the low viscosity simplifies PVC formulations.

H. R. Hutt

Joins International Latex

Henry R. Hutt has joined the Chemical Division of International Latex Corp. as southern regional sales manager, with offices in Atlanta, Ga. Mr. Hutt's responsibilities will include the sales of Tylac latices to the adhesive, textile, paint, and paper industries in the states of Georgia, Tennessee, North Carolina, South Carolina, Florida, and Alabama. A graduate of Michigan State University, Mr. Hutt was most recently associated with Wica Chemicals, Inc. as a sales engineer. Previously, he was employed by the Dow Chemical Co., both in its laboratories at Midland, Mich., and as a sales representative in the southeast.

Thiokol Earnings Up

A 28 per cent increase in net earnings for the first quarter of 1960 was recorded by the Thiokol Chemical Corp. with a figure of $1,044,398, compared with $817,820 for the same period a year ago. Earnings per share for the period ended March 31, 1961, amounted to 22¢, compared with 18¢ for the same period in 1960. Net sales for the first quarter of 1961 amounted to $41,948,941, a slight dip from the $41,996,134 figure reported for the same 1960 period. J. W. Crosby, Thiokol president, stated that improved chemical sales and reduction of the "overrun" costs on government contracts with which the company was confronted in 1960 resulted in increased earnings for this first quarter. He added that management expects general conditions to remain favorable for the balance of the year.

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By MELVIN NORD

Apparatus for Handling Thermo-Responsive Cements

U. S. Patent 2,969,056, issued January 24, 1961 to Hans C. Paulsen and assigned to B. B. Chemical Co., provides an apparatus for handling thermo-responsive cements in rod form.

The cement rod has a cross-sectional contour such that the ratio of surface area to volume is high, thereby facilitating the transfer of heat and the fast melting of the adhesive, while retaining sufficient stiffness to perform control and feeding functions required in a direct through-feed adhesive dispensing system. Thus the improved cement rod may be provided with opposed longitudinally extending V-grooves to facilitate coiling of the rod and also to expose increased surface area for melting the adhesive.

The patent describes a machine for folding the margins of leather shoe-upper parts in which this adhesive rod may be employed.

As shown in Figure 1, the rod (60) passes from a reel (not shown) to a guide tube (64) which is cut away to permit the engagement of the rod with feed wheels (66) which pass the rod along through an entrance gland (68) to a heated casing (70). In this casing, there is a driven disk (72) partly surrounded by a passage (74) extending from the entrance gland (68) to an outlet (76) where the melted cement is received by a pump (78) and forced through a pump outlet (79) and then through the passage (36) in the carrier (32). Within the passage there is a heating unit (80) to maintain the molten condition, and other heating units (not shown) are provided for heating the casing (70) and hence the disk (72).

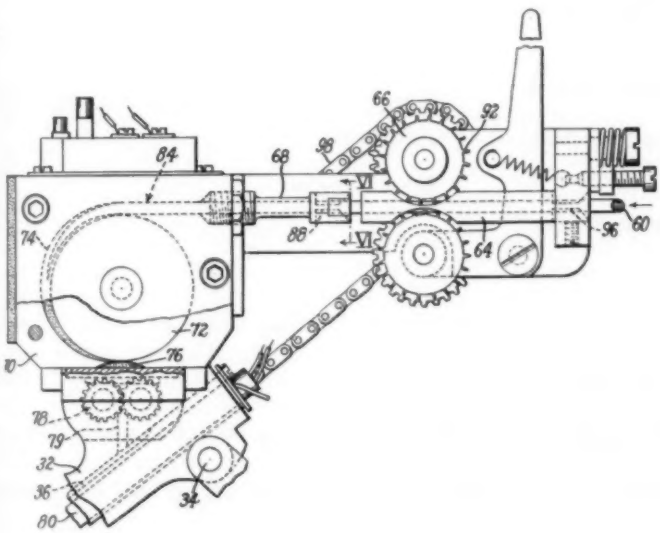

Figure 1

Dispersible Vegetable Gums

U. S. Patent 2,970,063, issued January 31, 1961 to Wesley A. Jordan and William E. Skagerberg, assigned to General Mills, Inc., provides a process for improving the dispersability of finely divided gum particles.

The gum particles are mixed with an aqueous solution to increase the moisture content of the gum particles by 20-40 per cent. The aqueous solution used is capable of hydrating the gum particles at a rate not in excess of 50 per cent of the rate at which water can hydrate the gum particles. The result is to effect a controlled hydration of the individual gum particles and to effect agglomeration of the individual gum particles into agglomerates. The agglomerates are then dried, to form dry agglomerates which readily disintegrate in water to yield individual gum particles.

Cobalt and Starch Compound

U. S. Patent 2,968,653, issued January 17, 1961 to Lyell J. Klotz and assigned to Lloyd Brothers, Inc., provides a process of preparing a water-soluble cobalt salt and soluble starch compound.

An aqueous solution of a water-soluble cobalt salt and soluble starch is prepared, containing one part of cobalt to at least 18 parts of soluble starch. An alkali hydroxide is added to the solution at 0° to 100°C. to raise the pH to 11. The resulting cobalt-soluble starch compound is recovered as a precipitate by adding a water-miscible organic liquid *i.e.*, a lower aliphatic alcohol or acetone.

Hot Melt Adhesives

U. S. Patent 2,970,974, issued February 7, 1961 to Charles P. Albus and Julian L. Azorlosa, assigned to General Aniline & Film Corp., provides a hot melt adhesive compatible composition.

The composition consists of 12.5-75 per cent by weight of polyvinyl methyl ether having a molecular weight of 2,000-10,000; and 25-87.5 per cent of a modifying agent consisting of rosin or an ester derivative of rosin having a melting point above 75°C.

ADHESIVES GUIDE

by JOYCE HURD

• A Practical Handbook

designed to serve as a guide to the types of adhesives available for bonding various materials in various applications. This new British publication covers adhesives used in woodworking, bookbinding, footwear, etc., and offers valuable data on the advantages of adhesive bonding and the classification of adhesives.

Topics Covered

Choice of Adhesives for Various Materials.

Encyclopedia of Basic Adhesive Types.

Classification of Manufacturers (British) by Basic Types of Adhesives Made

Catalog of Adhesive Manufacturers and Their Products

Trade Name Index (British)

Miscellaneous Adhesive Recipes

British Organizations Concerned With Adhesives

Bibliography

With contents including data on something like 400 individual adhesives made by about 100 different manufacturers, this publication will prove to be a valuable edition to your technical library. More than 50 main types of adhesives and their properties are covered.

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Dielectric Heat Setting of Bookbinding Adhesive

U. S. Patent 2,968,336, issued January 17, 1961 to Kenneth P. Martin and Richard J. Nadaskay, assigned to The Colonial Press, Inc., and National Starch Products, Inc., relates to the securing by adhesive of a backing or strengthening strip to the back of a group of assembled book pages by means of dielectric heating.

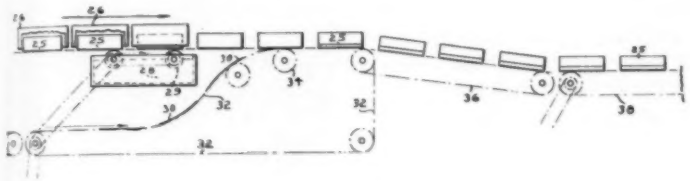


Figure 2

As shown in Figure 2, the separate book pages (25) may be carried between clamps (26) of a standard book conveyor system with their back portions projecting below the clamps. After the folded edges of the assembled pages have been trimmed away, the fluid adhesive (28) in a suitable container may be applied to the projecting backs of the projecting back edges of the sheets by means of the power driven rollers (29) which dip into the adhesive and carry the liquid into contact with the backs of the book sheets. These backs are to be covered with a paper cover (30).

A set of covers is fed forward serially into contact with the adhesive film applied on the back portion of the assembled book sheets. This backing may be fed into place by means of a power driven endless conveyor belt (32) onto which the book backings (30) are laid in a properly spaced relationship. The conveyor belt transports the backings to a location beneath the wet adhesive on the book. Here the backing is forced into adhering contact with the book by means of a belt supporting roller (34). Thereafter, the book is transported by a supplemental endless conveyor system (36) to another power driven conveyor (38) which transports the books serially to and through the heating zone.

The heating zone is preferably enclosed in a tunnel-like structure made of aluminum metal and substantially enclosing the traveling books so as to serve as a shield for the electric field.

The adhesive is selected to have the essential properties of being a dielectrically stable material of low electrical conductivity and low heat conductivity in both the wet film and the dry film state. The evaporation of water by the dielectric heating leaves the adhesive as a flexible film of strong internal cohesion capable of holding the book pages firmly in position. The adhesive should have a low ionizable salt content, and its film in the wet stage should have sufficient viscosity and tackiness to serve adequately when the book is bound in a "Perfect" binding machine.

The patent describes various adhesives having these characteristics, *e.g.*, 78 per cent by weight of an aqueous emulsion of polyvinyl acetate (55 per cent by weight of solids), 9 per cent of dibutyl phthalate, 1 percent of polyvinyl alcohol, a standard silicone defoamer 0.25 per cent and added water to make 100 per cent.

Dielectric heating to evaporate the water of the emulsion and set the adhesive is effected by means of an electromagnetic field of suitable radio frequency, which may be from 5,000,000 to 200,000,000 cycles per second, but preferably is in the range of ten megacycles per second. The voltage may be as high as 15,000 volts, more or less. A suitable wattage may be from five to ten kilowatts. By largely localizing an alternating field of these characteristics in the applied adhesive film, the water is quickly removed while the book is traveling through the heating zone at a suitable rate coordinated with other book manufacturing stages. In this form of heating, the electric field permeates the entire band or film of adhesive and causes a substantially equal heating throughout, except as the outer layer may be slightly cooler due to conductivity or radiation.

Other Patents of Interest

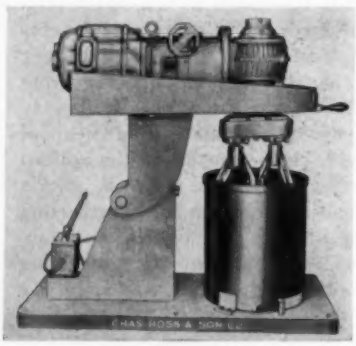
Subject	Inventor or Assignee	Patent No.	Date
Adhesion of rubbery polymers to fibrous materials	Esso Research & Engineering Co.	2,968,587-8	1/17/61
Adhesive protective pads	Miles E. Landau	2,969,062	1/24/61
Pressure sensitive adhesive tape	Phillips Petroleum Co.	2,969,143	1/24/61
Adhesive bandage	Johnson & Johnson	2,969,144	1/24/61
Packaged adhesive bandage	Johnson & Johnson	2,969,145	1/24/61
Non-sagging joint sealing compositions	Minerals & Chemicals Philipp Corp.	2,969,337	1/24/61
Package for adhesive bandages	The Seamless Rubber Company	2,969,872	1/31/61
Self-gelatinizing starch bearing grains	Anthony J. Nugey et al	2,970,054	1/31/61
Method of joining metal surfaces	American Can Co.	2,970,077	1/31/61
Plastic cement composition	Folsom E. Drummond	2,970,124	1/31/61
Preparation of amino ethers of starch	American Maize-Products Co.	2,970,140	1/31/61
Tape roll holder	Waldorf Paper Products Company	2,970,686	2/7/61
Manufacture of cement clinker	Klaus Dyckerhoff	2,970,925	2/7/61
Pressure sensitive tape	Bemis Bro. Bag Co.	2,971,863	2/14/61
Adhesive composition	Bell Telephone Laboratories, Inc.	2,971,876	2/14/61
Purification of phosphate-modified starches	International Minerals & Chemical Corp.	2,971,954	2/14/61

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D.C., for 25 cents each. Do not send stamps.

new equipment

Changeable Can Mixer

Equipped with dispersion type stirrers and a simplified hydraulic lowering and raising device, the Double Planetary Changeable Can Mixer is available in 8, 12, and 20 gallon sizes. The mixer features a



compact built-in hydraulic control for raising and lowering stirrers from the can. The stirrers overlap the center of the can as well as each other. In operation they rub close to each other and to the can sides to develop a tremendous compressive and shearing action on the heaviest paste material, the manufacturer reports. Standard units of the mixer are provided with a variable speed motor drive. Vacuum covers or jacketed cans are among the optional features. *Charles Ross and Son Co.* **E-318**

Heat Seal Labeler

The Masterline Neckwrap Labeler automatically applies paper wraparound labels to the necks of bottles at speeds up to 180 bottles per minute. The unit applies heat seal labels only, eliminating the use of liquid adhesives. The delayed-action type heat-seals are used with the heat applied directly to the adhesive side, permitting a wide choice of papers, foils, inks, and embossings, according to the manufacturer, with no possibility of destroying design, no "picker" marks on labels, no bar spots, and 100 per cent adhesion of the label to the container. Smooth, continuous motion makes the machine ideally suited for lightweight glass. The labeler is also said to offer complete label-positioning control, and will accommodate round, square, or flask containers from ½ pint to 1 quart capacity. *Gisholt Machine Co.* **E-319**

Conveyor Feeder

Conveyor feeder — Series C, is offered for use with hard-to-handle materials, and is designed to feed the larger sizes of flaked, fibrous, and similar materials, ranging up to 1½ inches in diameter. The feeders are two-speed single conveyor belt units. Two control gates regulate feed flow rate. The first, a metering gate, controls the bulk material being fed to the belt. The second, a dribble control gate, suspended above the belt, controls the material flow from the belt to the containers. The conveyors handle up to 80 CFM, operating at 50 per cent efficiency, but operating efficiencies may be higher or lower depending upon the type of material being fed. Two models are available. *Thayer Scale Corp.* **E-320**

Portable Magazine Loader

Model ML-1 magazine loader is a new accessory for the remote spray coater HD-3, and is designed to facilitate the handling of axial lead components. The unit can also be used with Model HD-2 remote spray coaters after factory revision. The loader stacks 40 loaded trays of axial lead components in a portable magazine, after they have passed through the painting station of the spray coater. The magazines may then be transferred to baking or other processing operations. The loader is 57 inches high and requires a floor space of 14 by 19 inches. *Conforming Matrix Corp.* **E-321**

Container Type Hygrometer

Abbeon Model No. R560 container type hygrometer is designed for obtaining the relative humidity of samples of grainy or powdered materials. The instrument consists of two parts: an especially calibrated Abbeon hygrometer, and an oxidized aluminum container which holds the hygrometer. The sample

to be tested is placed in the container and the hygrometer is inserted into position and left there for approximately 20 minutes, when it will indicate the relative humidity of the sample. Once the relative humidity is known it is then possible to determine the percentage of absolute moisture of the sample by consulting a table of humidity equilibrium, which is included with the instrument. The tables are calibrated in 2 per cent increments from zero to 100 per cent. Model No. R560 has an over-all diameter of 4", a height of 3¾", and has a measuring range of zero to 100 per cent relative humidity. *Abrax Instrument Corp.* **E-322**

Dual Temperature Detector

A new dual element tip-sensitive temperature detector permits measuring the same temperature at two different locations, or permits indication and recording simultaneously. Model 313 resistance temperature detector has two concentric elements, making it, in effect, two detectors in one housing. It is 5/16 inch in diameter, and can be obtained in lengths up to 10 feet. The model is supplied with a spring-loaded holder to press the tip of the detector against the surface being measured. *Thomas A. Edison Industries.* **E-323**

Strapping Tape Dispenser

The Strap-It 4W is a portable, hand-operated machine which dispenses, applies, wipes down, and cuts tape up to two inches wide in one operation. The cast aluminum

dispenser is lightweight and well balanced to minimize worker fatigue. A surgical steel blade with a shear cutting action cuts any tape backing cleanly. After the desired length of tape is cut, a free end remains as a self-starter for the next application. The Strap-It 4W holds tape up to 120 yards long, and dispenses cloth, paper, film and foil tapes. *Permacel.* **E-324**

Multi-Purpose Spray Gun

The R-2 All Materials Spray Gun has been designed to handle high and low viscosity materials in the range of 10 to 18,000 centipoises. It is claimed that it will spray epoxy, polyester, plaster, and polysulfide type materials, as well as higher viscosity gel coats and adhesives since the recent development of an accessory which preheats resins while they are being sprayed. In addition to applying these materials faster than by conventional methods, the manufacturer reports, hte heating process starts the reaction or polymerization to speed up the cures. Temperatures of 250°-300°F. can be achieved. The spray gun features a nozzle lid assembly which permits spraying from an expendable throw-away paper cup, or production spraying from a bucket with a newly-developed nozzle hose assembly. Air pressure requirements are 40 to 90 pounds, depending on the viscosity of the materials being sprayed. *United States Gypsum Co.* **E-325**

Electric Tube Furnace

An electric combustion tube furnace, Despatch Model SC-32, incorporates a new type of power control said to allow greater accuracy of temperature control. This control system is called Thermionik Power System, and uses thyratron electronic tubes in place of conventional contactors and saturable reactors. The power system is usable with any dc producing or proportioning slide wire control system. It may also be operated manually. The tube furnace produces 2600°F. maximum; it provides a 12 inch uniform heat zone in a 2½ inch o.d. ceramic tube; and is rated at 7 kw on 220/1/60 vac. The model is mounted on a steel-enclosed base which houses instrumentation and auxiliary equipment. It is available with automatic indicating type controls and mounts for two to four inch o.d. tubes, and as a muffle-type. *Despatch Oven Co.* **E-326**

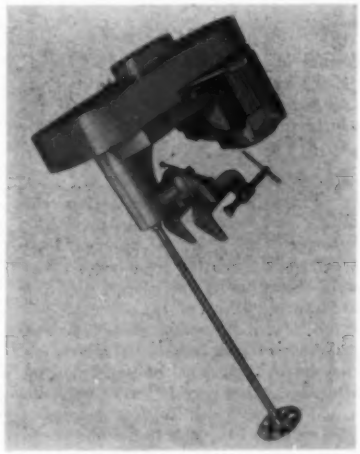
Multi-Rez-Processor

The Multi-Rez-Processor, a complete production unit for proportioning, dispensing, and mixing multi-component reactive resins such as epoxies and polyurethanes, features a re-designed proportioning linkage called the Proportion-Variator. Proportional accuracy of the two component media dispensed is maintained through mechanical linkage operating positive displacement pumps. The new design allows for simplified changes of ratio, without substitution of sprockets or gears, with a simple adjustment of an arm around a calibrated dial. This broadens the ratio range, allowing settings which range from 1:1 to 100:1. The processor will also dispense an adjustable predetermined volume of the two components in proportion. Blending of the resin mix is accomplished by a motorized mixer with a Teflon impeller. *CPM Special Machinery Corp.* **E-327**

FOR MORE INFORMATION on these new products use the Readers Service Coupon in this issue.

Wizard Portable Agitator

The Wizard portable agitator delivers speeds of 260 to 4000 rpm from an explosion-proof, single-speed motor. Said to offer all the advantages of variable-speed



portable agitators, the Wizard produces output speeds over a nine to one range. A turn of the handle allows immediate speed adjustment up to 2400 rpm; speeds up to 4000 rpm are achieved by changing one V-belt and driven pulley. The new unit is recommended by the manufacturer for dispersing paint pastes, thinning and tinting paints, and a variety of other mixing jobs. *Patterson Foundry & Machine Co.* **E-328**

Air Pollution Test Unit

Portable equipment for air pollution testing is available for use in determining gaseous and particulate pollutants in the atmosphere. The compact, light-weight apparatus is suitable for testing in emergency or preliminary field work and, according to the manufacturer, can be operated by persons with little or no training in chemistry. Gaseous pollutants that can be measured with this equipment are nitrogen dioxide, hydrogen fluoride, chlorine, sulfur dioxide, oxidants, ammonia, formaldehyde and hydrogen sulfide. Particulate pollutants that can be detected include mercury, lead copper, chromate, selenium, iron, nickel, arsenic, phosphate and sulfate. *Central Scientific Company.* **E-329**

book reviews

Manual of Man-Made Fibers. ***By C. Z. Carroll-Porczynski. Published by Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N.Y. 5½ by 8¾ in. 304 pp. $10.00.***

Under the sub-title, "Their Manufacture, Properties, and Identification" this volume delineates the distinguishing characteristics of natural polymer man-made fibers; synthetic polymer man-made fibers, inorganic fibers, and textured yarns. Much of the material presented here has been condensed to very readable, succinct flowsheets, tables, and stress-strain diagrams of tensile properties for fibers in the dry, wet, and heated states. A list of recent publications on each fiber and numerous photomicrographs and X-ray diffraction photographs are included in the volume.

As a manual intended for the reference of persons dealing with fibers on a day-to-day basis, the organization is superb, containing, in addition to an adequate index, a listing of producing companies throughout the world, a section on fiber identification by chemical analysis, and photographs as required.

Text matter as such is mostly in outline form. For instance, under the chapter heading, Synthetic Polymer Man-Made Fibers, the listing "Acrylic Fibers" is broken down to (1) Acrilan, (2) Acrilan 16, (3) Acrilan Carpet Fiber (4) Creslan, (5) Courtelle, and (6) Orlon.

Under each of these are given the chemical base, physical and chemical properties, dyeing characteristics, electrical properties, simplified techniques of identification, and the producer. The flow charts and tables mentioned above supplement each of these listings.

As a working manual this volume is described by its publisher as "the most comprehensive one-volume summary of technical information on man-made fibers." The book should be of primary interest to those concerned with textile research and production.

The Chemistry of the Terpenes. ***By A. R. Pinder. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N.Y. 6 x 10 in. 223 pp. $8.25***

As defined here, terpenes are compounds which are constituents of essential oils, and which contain carbon and hydrogen, or carbon, hydrogen, and oxygen. This volume, prepared primarily as a text for, and at the request of, honors undergraduates at the University of Wales, is designed as intermediate between the more general text books and the comprehensive monographs in the literature.

In adhering to these limitations, the author, Senior Lecturer in Organic Chemistry, Cardiff, at the University, has placed his emphasis on the more simple mono-, sesqui-, and diterpenes, covering them in somewhat greater detail than the more complex compounds. He has also made use of self-explanatory flow sheets in describing many degradations and syntheses.

After an introductory set of chapters on the essential oils, and the techniques for determining the molecular structure of the terpenes, one chapter each is devoted to acyclic, monocyclic, and bicyclic monoterpenes; thence to sesquiterpenes, diterpenes, triterpenes; tetraterpenes; rubber and related compounds, and biogenesis of terpenes.

As might be expected, the text is exclusively academic in nature, with little or no emphasis placed on the industrial or commercial aspects of the title subject. The chapter on rubber (which resembles certain of the simple terpenes in its structure) presents the evidence for present conclusions about the arrangements of the isoprene units after polymerization.

Introduction to Petroleum Chemicals. ***Edited by H. Steiner. Published by Pergamon Press, Inc., 122 E. 55th St., New York 22, N.Y. 6 x 9 in. 200 pp. $8.00.***

This survey is based on a series of lectures given at the Manchester College of Science and Technology in 1959 by chemists and chemical engineers engaged in industry in England. Thus the English orientation of the industrial procedures described presents an interesting contrast to practices in the United States, to which the authors sometimes refer.

Within the last thirty years, the synthetic organic chemical industry has undergone considerable change, with petroleum gradually replacing coal as the raw material for synthesis; consequently, this volume. In the introduction, Sir Robert Robinson states that the essays here give "an excellent idea of the directions of recent progress . . . It is safe to say that a major development of the next few years will be in the elastomer field."

The topics covered in the eight chapters (all of which are carefully footnoted, charted, and referenced, and which, in uniformity, reflect the work of a very competent editor) range from general processes to specific products. Company affiliations represented by the authors are equally varied. A listing of these, and the chapters in the book, follows:

Cracking Processes for Olefins (I.C.I. Heavy Organic Chemicals Ltd.); Separation Processes for Olefins (Petrocarbon Developments Ltd.); Products from Ethylene and Propylene (The Distillers Co. Ltd.); Polymers from Ethylene and Propylene (Petrochemicals Ltd.); The Production and Use of Butadiene (Esso Research Ltd.); Aromatics from Petroleum (Shell Chemical Co. Ltd.); Styrene and Polystyrene (Rubber Regenerating Co. Ltd.); Acetylene from Hydrocarbons (British Oxygen Research and Developments Ltd.); and Carbon Black (Cabot Carbon Ltd.).

Like any such compilation, the inherent limitations of this one are apparent: differences in approach by the specific authors, in depth of their treatment, in their style and presentation; but as a survey of many of the important aspects of the field, the book has merit.

Trade Literature

VINYL SOLUTION RESINS. Information on the preparation and application of vinyl solution resins for coating metal, wood, paper, fiberboard, and rubber is contained in Service Bulletin G-15. Included in this 24-page booklet is a listing of the physical properties of Geon resins suitable for solution coatings including those approved by the U.S. Food & Drug Administration for food packaging applications. The booklet explains methods of determining the best resin solution for a particular application based on the resin's molecular weight, solubility and solids content, and the physical properties desired in the final coating. In addition, the brochure contains detailed information on the formulation of these solutions. Included in this section is a discussion of mixing techniques, solvents, plasticizers, stabilizers, pigments, resins additives, and viscosity characteristics. *B. F. Goodrich Chemical Co.* **L-372**

Liquid Meter. A 1-1½ inch stainless steel liquid meter is described and illustrated in this four-page circular. The literature, which is complete with meter specifications, points out advantages of metering liquids, including closer control in batch mixing and processing operations, speed-up of production and prevention of human errors, better plant housekeeping and safety, and improved and more convenient record keeping. Features of the meter, including the positive adjustments, easy-to-read numerals, sealed permanently lubricated gear train, exposed stuffing box, convenient totalizer, and easy

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Subscribers to ADHESIVES AGE may now obtain, from one central source, technical literature dealing with all aspects of the adhesives industry. One or more of the books listed here may be of invaluable assistance to you. Look this list over and check the books suited to your needs.

- **Adhesive Bonding of Reinforced Plastics—H. A. Perry. $8.75.** Survey of the design and assembly of structures and products, particularly glass-fiber-reinforced plastic products, by means of adhesives. Gives data on equipment and methods used to produce adhesive bonded joints. ☐

- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice —A. X. Schmidt and C. A. Marlies. $14.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives, their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research —G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Epoxy Resins—Irving Skeist. $5.50.** A chapter on adhesives is included in this complete study of the entire field of epoxy resins. The author gives formulations, trade names, methods of manufacture and applications. ☐

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Trade Literature (Cont'd.)

positive reset are discussed. A wide range of registers are also illustrated and described. *Neptune Meter Co.* **L-373**

AIR DRIED PROTECTIVE COATING. This technical Bulletin describes a protective coating (Plasite No. 7155) which cures at room temperature, and is designed for use as a lining for tanks and for storage or handling of high purity water at temperatures around 200°F. The coating is said to have excellent resistance to high temperature brine, caustic solutions, and solvents. The bulletin includes records of six years of service in hot water storage tanks, condensate receivers, and similar applications. *Wisconsin Protective Coating Corporation.* **L-374**

ADHESIVES FOR CANNERS. Pick-up, lap-end, spot labeling, glass labeling, and case sealing adhesives are discussed with full technical information as to dwell time, viscosity, tack, pot life, and instructions for clean-up in this booklet. Under the pick-up adhesives, the booklet details nine grades of hot pick-up gum, each one designed for specific pot temperatures and can conditions. Also included is a section on the proper mixing and storing of adhesives. *H. B. Fuller Company.* **L-375**

ALCOHOL BULK STORAGE. Government regulations relating to storage of specialty denatured alcohol and proprietary solvents are covered in this eight-page "Bulk Storage Guide." The bulletin has sections on suggested tank design, auxiliary equipment including pumps, pipe and fittings, valves, electrical grounding procedures, vents, and measuring devices. Included are drawings of typical above and below ground storage tanks, and a typical gauging well and methods of anchoring underground tanks. *U.S. Industrial Chemicals Company.* **L-376**

EPOXY CURING AGENTS. Technical Data Sheet No. 2 A/O is a 10-page bulletin which describes liquid epoxy curing agents that offer long pot life and low toxicity. The bulletin covers typical physical properties, pot life and gel time, electrical properties, thermal stability, water absorption, chemical resistance, cure cycles, and handling. *U.S. Borax & Chemical Corp.* **L-377**

FOR MORE INFORMATION on the literature items described here, use the Reader's Service Coupon in this issue.

SCOTCHCAST ELECTRICAL RESIN. Properties and data for Scotchcast brand electrical resin No. 241 are listed in this four-page brochure. Suggestions for handling, storage, and use are included with a list of physical and electrical properties covering a two-part filled, semi-flexible epoxy resin system of 100 per cent solids. Charts show a comparison of pressures exerted by rigid and flexible resins during thermal cycling, viscosity characteristics of Scotchcast No. 241 at various oven temperatures, and curing times required at various temperatures. *Minnesota Mining & Mfg. Co.* **L-378**

RAY-BOND ADHESIVES. Bulletin No. 701 is a 20-page, two-color booklet which describes Ray-Bond adhesives. Subjects covered include selection of adhesives; bonding techniques; testing; common causes of bond failure; quality control inspection, and characteristics of principal Ray-Bond adhesives. The booklet also contains a glossary of adhesive terms. *Raybestos-Manhattan, Inc.* **L-379**

LAMINATED PLASTIC SHEETS. Grades, properties, and sizes of the manufacturer's line of laminated plastic sheets, rods, tubes, and fabricated parts are given in this 8-page catalog. Described are manufacturing techniques, research, development, and custom molding of the firm's line of Insurok laminates. *Richardson Co.* **L-380**

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in passing

Improving on Nature

Vinyl film, photography, and ordinary plywood have been teamed to produce an economical, easy-to-maintain wall paneling with all the appearance of fine wood. Recently introduced, the paneling is made by laminating a thin film of printed vinyl film onto plywood. For the printing, a photograph of high quality wood is used with a gravure printing press to give an exact reproduction of the wood grain on the plastic. The panels are made in 4 by 8-foot and 4 by 10-foot sections in ¼ and ¾-inch thicknesses. Patterns faithfully simulate cherry, natural oak, natural walnut, birch, bleached walnut, rosewood, gray oak, silver walnut, and mocha walnut. They can be wiped clean easily, and resist abrasion and most materials that disfigure natural woods.

It's Your Dime

Many of the inquiries that find their way to the *Adhesives Age* office sound weird on first hearing, but a few questions will generally bring the matter into proper perspective. This by way of preamble to explaining why we held fire when a voice on the telephone the other day asked if we had any information on igloos.

"I think you may have the wrong number, sir," we said in even tones.

"Isn't this *Adhesives Age*," the voice insisted.

"Yes."

"Well don't you have any information on those adhesives used by Eskimos?" came the answer as we gently settled the phone back on the hook.

Even on Sunday

A Philadelphia advertising agency has been organized to produce ads that are really on the ball—a golf ball. Companies which have already gone into golf ball advertising include Pittsburgh Plate Glass, Westinghouse Electric, York Corp., Hotpoint, and Dow Chemical. The balls are made for Golf Ball Advertising Co. by Plymouth Golf Ball Co., manufacturer of private label golf balls.

Rover Takes Over

A Milwaukee motorist we heard of is trying to figure out whether it would be easier to teach his dog to drive or to just sit still. Recently, he parked his car in town and hopped out to do some shopping. The pooch, a German shepherd, slid over into the driver's seat, kicked the car into gear, and took off—into a store window.

Hold It!

Plastics are often referred to as miracle materials and credited with the ability to do just about everything but talk. Or can they? Well, if they can't talk, at least they can defend themselves on occasion.

A photographer we heard of, an artistically minded chap, was recently assigned to take a photograph of a high density polyethylene pipe held in coils by steel bands. After some professional squinting through the groundglass, he decided that the coiled pipe was much too static. Grabbing a pair of clippers, he boldly stepped up to the reposing coil and snipped off the steel bands. He was immediately attacked by several yards of swirling plastic.

He's doing well, thank you.

What's in a Name?

American business is out on a title binge. For example, "salesmen" are rapidly becoming as extinct as the buffalo and in their places we now have sales engineers, technical service specialists, regional managers, etc. From what we can see, the jobs are the same; the only thing that's different is the moniker.

The trend has gone so far that in some offices what used to be known as pool typists are now grandly referred to as "transcription specialists." Remember the old fashioned secretary? She's now an "administrative assistant" if she works in the business district, a "girl Friday" if her office is on Madison Avenue or the local equivalent.

An Electronic Squeeler

A handy little gadget being marketed by a Buffalo electronics firm sets up a squawk that will warn drivers as they come close to a hidden police radar station. About the size of two packs of cigarettes, king size, the "Radar Sentry" will begin buzzing about a quarter of a mile from the danger zone.

Legal? Moral?

About as much so as radar is for the police, is the feeling in some quarters.

High Cost Seating

Arrangements were made recently for the sale of a seat on the New York Stock Exchange at $210,000, up $10,000 from the previous sale on March 20. It was the highest price paid for an Exchange seat since August 4, 1933, when a membership changed hands at $240,000. The current market for a seat is $200,000 bid, $225,000 asked.